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Preface

Tobacco research and development Section encompasses an extremely broad range of activities and potential to overcome the issues faced by tobacco growers in field. The role of R&D in terms of improvement in already existing Tobacco Varieties & developing of new varieties with improved yield potential, resistance to diseases insects/pests, drought tolerant and producing quality leaf of tobacco is self-evident. The Pakistan tobacco board is committed to high quality of R&D for improving tobacco products to meet demands of the world market is a good sign.

In order to achieve the aim of our establishment, we carry out field experiments at our Research Stations through our qualified staff. Pak Tobacco is a good source of information and serves as a forum for the exchange and dissemination of research, knowledge, and innovative practice related to the broad spectrum of Tobacco Research and Development. It aims to provide a forum for findings, reviews, and conceptual papers on the many aspects of tobacco, including research on chemistry of tobacco leaf, protection measures against disease & insects/pests, study on exotic hybrids and research on tobacco cultural practices to be utilized by farmers for better production and quality.

Message

Research and Development for improvement and promotion of high quality tobacco products occupies a critical position among the delegated charter of duties and functions of Pakistan Tobacco Board. It plays a vital role not only as an important link in the value addition chain acting as a bridge between the end market, both domestic as well as international, and the farmer but also ensures that the latest scientific and technological advances made in the world are passed on to the growers to upgrade varieties, grades, yields, production and quality of tobacco.

Recognizing the significance of Research and Development PTB brings out this journal on a bi-annual basis to disseminate findings of research work among all the stakeholders. The aim of this plan of action is to change itself into a dynamic organization playing a facilitative role to transform the tobacco sector into a vibrant, quality conscious, export oriented area of economy with benefits to the growers, the manufacturers as well as country at large.

ATAULLAH

SECRETARY, PAKISTAN TOBACCO BOARD

Message

One of the main feature of the economic policies being pursued by Pakistan is export led economic growth leading to improved and fairly distributed incomes and opportunities, the alleviation of poverty and human resource development, competitive and fast evolving field of international trade, a great deal of effort would be required by countries like ours not only to retain their share, but to further enlarge it in the world market through observance of the highest standards of quality and competitiveness.

Pakistan Tobacco Board is committed to high quality of R&D for improving tobacco products to meet demands of the world market. Research carried out by qualified scientists at research stations and model farms responds to the problems being faced by growers at fields in terms of plant diseases, pest resistance, outmoded agronomic practices and obsolete curing techniques. Continuous Research and Development ensures keeping up with the latest development in the field of technology, productivity, quality and standards compatible with international norms.

The publishing of R&D findings in the form of this journal Pak Tobacco on regular basis is laudable, although efforts need to be made to further enlarge the scope of its contributors through participation from other public and private R&D agencies and organizations. Suggestions, if any, for improvement would be most welcome.

TAIMUR TAJAMMAL
CHAIRMAN, PAKISTAN TOBACCO BOARD

Effect of Split Application of Solo-Potash as foliar spray on the yield and quality of FCV tobacco

Seema Shah[1], Syed Asif Shah[2], Muhammad Asmat Ullah[2], Muhammad Bilal Anwar[1], Kamran Khan[1], Kiran Khan[3] ,Abdul Rehman[1]

ABSTRACT

A plot experiment was carried out in Tobacco Research Station, Khan-Garhi Mardan during 2014-17 to study the effect of split application of solo-potash as foliar spray on the yield and quality of FCV tobacco using randomize complete block design (RCBD) with three replicates. Solo-potash foliar spray was done at knee and flowers button stage of plants. The noted data of agronomic and chemical parameters viz; leaf area (cm^2), cured yield ($kgha^{-1}$), nicotine (%) and reducing sugar (%) contents showed significant difference ($p \leq 0.05$). The means of noted parameters were separated using LSD test. Leaf area ranged from $1018.16cm^2$ to $1217.57cm^2$. Cured yield ranged from $3474kgha^{-1}$ to $4108kgha^{-1}$. Nicotine contents ranged from 2.39% to 2.76%. Reducing sugar contents ranged from 13.90% to 18.41%. NPK+ Solo-potash Treatment (N:70, P:70, K:50 + Solo-potash:$10kgha^{-1}$) showed best results among other treatments in cured yield of K-399 variety. To get maximum cured yield of FCV tobacco Solo-Potash split Application as foliar spray with NPK fertilizer ratio (70:70:50) should be considered.

Key words: Solo-potash, Tobacco, N, P, K

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INTRODUCTION

Tobacco (*Nicotiana tobaccum* L.) is a prominent cash crop and major source of income of farmers in Pakistan. Before independence of Pakistan, *N. tobaccum* was cultivated in KPK, Punjab and Sindh for local consumption in hukka, snuff and chewing. In Pakistan, area under tobacco cultivation is 51300 hectares with a production of 2004kg/ha, while it is cultivated on 32500 hectares with a yield 2406kg/ha in Khyber Pakhtunkwa (MINFAL, 2010-11). KPK produced 78% of the total production of Pakistan (MANFAL, 2011).

The activities of more than 50 enzymes are dependent on or stimulated by potassium. Potassium is important on hydrocarbon and protein metabolism, photosynthesis, cell division, cell growth and osmotic pressure (Wang, *et al.*,2013). Potassium also is important for regulation of stomata opening and closing, the phloem transportation, onions and cation balance, increasing pest resistance to coldness and drought, increasing disease resistance, nitrogen fixation in legumes and improving the quality of agricultural products (Umar, 2006).

In an experiment on tobacco for cigar production, the effect of sources of K for fertigation was investigated showing the benefit of potassium sulphate on quality of tobacco when applied over a longer period. Finally, an experiment with foliar applications of potassium sulphate in China is presented, illustrating the positive effect of foliar applied K on K content in the tobacco leaf (Marchand, 2010). The available potassium in earth's crust is around 1%. The absorbed potassium is not comparable with required nitrogen. Potassium amount varies in different soils and annually consumption of fertilizers is necessary in some soils due to shortage of potassium. In some other soils, potassium accumulation is too high so that even after years of plant cultivation and leaching which discharges potassium from soil, there is no need using fertilizers (Shahdi Komleh, 2002). Solo-potash has specific advantages compared to other potassium fertilizers, such as higher solubility than of potassium sulfate. Sulfate ion causes reduction on soil pH which is very effective in saline soils, while potassium chloride causes plant toxicity and increasing salinity due to chloride containing. Potassium effects organic acid metabolism and is strongly related to the burning properties of the cured leaves (Drossopolulos *et al.*,1997).

Salinity is a major a biotic stress which adversely affects plant processes at physiological, biochemical and molecular levels and reduces plant productivity (Tester and Davenport, 2003 and Munns, 2002). It is well accepted that K concentration is much less in plants grown with high sodium chloride; therefore, supplementary K application could enhance the K concentration within the plants. These results suggest that supplementary K can improve plant growth, yield and its quality of plant grown under saline conditions (Greenway and Munns, 1980). Potassium is essential in maintenance of osmotic potential and water uptake and had a positive effect on stomatal closure which enhances tolerance to water stress (Epstein, 1972).

Potassium plays a vital role in increasing the yield and quality of plant. Foliar application of (K) as a fertilizer application is considered active way and lead to increases the absorption of potassium and other nutrients, in addition to enhancing the nutrient use efficiency and enhance the crop growth under saline soil by decreasing the salts accumulation and by maintaining the optimum nutrient level in the root zone of plants (Mohamed *et al.*, 2010).

Potash amount of cultivars related to soil potash, absorption, Transport, partitioning percent to parts and environmental conditions (Elliot, 1968; Ghulam and Gul,1992). High amount of potash in different plant parts varieties indicates high relative growth rate of parts and available potash in soil at early stages growth. Plant senescence, decrease of plant parts activity and soil potash may be related to decline potash in cultivars parts at late stages of growth. Stem and root potash high contents in madole and DRV1, (respectively) were due potash Rapid translocation to stem from root, root high activity and improved k-use efficiency this cultivars (Janardhan *et al.*, 1990).

In Pakistan, most soils contain relatively large amount of total K as a component of insoluble minerals, and only a small fraction is present in available form to plants. Most of the soils have <150 mg kg^{-1} of exchangeable K, which is considered a critical limit for soil K deficiency (Bajwa and Rehman, 1996). The potash use as mineral fertilizer is very low in Pakistan and its application for agronomic crops is 0.8 kg ha^{-1}, while world average is 15 kg ha^{-1} (MINFAL, 2007).

MATERIAL AND METHODS

A plot experiment was carried out at Tobacco Research Station, Khan Garhi, Mardan in the year of 2014-2017 to observe the effect of split application of solo-potash as foliar spray on the yield and quality of FCV tobacco using randomize complete block deign (RCBD) layout with three replicates. Solo-potash foliar sprays were done in knee and flowers button stage of plants. Different treatments of Solo-potash were used. NPK fertilizer was applied before first routine irrigation after stress period. Row to row distance was kept 90cm while plant to plant distance was 60cm with in row. Seedlings have 5-6 inches height with soil ball have been transplanted in plot. All approved practices were followed from transplantation till curing of leaves in barn.

Agronomic Parameters

Agronomic parameters viz; leaf area (cm^2) and cured yield ($kgha^{-1}$) were noted on 10 randomly selected plants from each replication of a treatment.

Treatments Codes	Treatment kg/ha	N	P_2O_5	K_2O
T_0	0	70	70	50
T_1	2	70	70	50
T_2	4	70	70	50
T_3	6	70	70	50
T_4	8	70	70	50
T_5	10	70	70	50
T_6	12	70	70	50

Leaf Area (cm^2): Leaf area, length and breadth of 5^{th}, 10^{th} and 15^{th} leaf of 10 randomly selected plants was measured in each replication of every treatment and leaf area (cm^2) was calculated by using the following formula (Idrees and Khan, 2001):

$$\text{Leaf Area cm2} = \text{Avg. length} \times \text{Avg. width} \times 0.644$$

Where 0.644 is Correction Factor

Cured Yield ($kgha^{-1}$):

Cured leaves of every replication in each treatment was collected and counted. Cured leaves kg^{-1} were weighed on an electric scale and leaves were counted. All the cured leaves were weighed and the yield from one replication was converted into yield $ha^{-1}$for each replication in a treatment. Cured yield h^{-1} of each treatment was calculated from average of three replication data (Idrees and Khan, 2001):

$$\text{Cured leaf yield (kg ha}^{-1}\text{)} = \frac{\text{Total cured weight} \times 10000 \text{ m 2}}{\text{Net area Harvested}}$$

Chemical Constituents

Leaf samples were collected from plants selected for agronomic parameters. These samples were chemically analyzed for percent nicotine and percent reducing sugar contents in Chemistry

Laboratory of TRS, Mardan. The details of the treatments are as under:

Nicotine Analysis (%): Leaf samples of every replication in each treatment were collected from randomly selected 10 plantsand composite sample of half kg powered sample were made for percent nicotine analysis. Nicotine content was calculated by the following formula as used by Idrees and Khan (2001):

$$\text{Nicotine content (\%)} = \frac{\text{V1} \times \text{N} \times 32.45}{\text{Weight of sample}}$$

V_1 = Volume of titrant for non-alcholic aliquot

N = Normality of Perchloric acid

Reducing Sugar (%):

For reducing sugars analysis the same sample prepared for nicotine content were used and

Followed the procedure suggested by Lane and Eynon (1986) with the help of following formula:

$$\text{\% Reducing Sugar} = 500\ \text{w x } 1000/\text{t. w } (100 - \text{m})$$

Where t = titration (solution „A), w = weight of tobacco. m = percentage moisture content of tobacco

Statistical Analysis: All the above parameters were subjected to analysis of variance (ANOVA) technique using (Statistix® 8.1) software. Significant means were compared by using LSD test at α <0.05.

RESULTS AND DISCUSSION

The recorded data of agronomic and chemical parameters were analyzed statistically and results are presented in the given below figures.

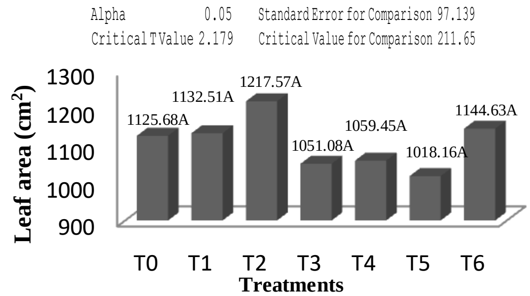

Figure 1: Effect of split application of Solo-potash on leaf area (cm^2) of K-399 variety

The effect of split dose application of solo-potash on leaf area was found statistically non-significant (P<0.05) Figure-1 showed that leaf area ranges from 1018.16cm^2 to 1217.57cm^2. The maximum leaf area 1217.57cm^2 was observed in T_2 followed by T_6 1144.63cm^2 while the lowest 1018.16cm^2 was noted in T_5. Control dose (recommended NPK dose) showed leaf area 1125.68cm^2. LSD test revealed that means of treatments were similar with one another.

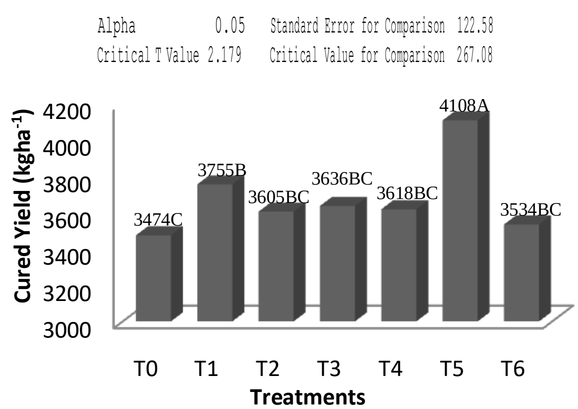

Figure 2: Effect of split application of Solo-potash on cured yield (kgha^{-1}) of K-399 variety

Looking at figure-2, the cured yield ranges from 3474kgha^{-1} to 4108kgha^{-1}. The effect of split application of solo-potash on cured yield was observed highly significant (P<0.05). The maximum yield (4108kgha^{-1}) was observed in T_5 while minimum cured yield (3474kgha^{-1}) was noted in T_0. Means of treatments were separated using LSD test. Different characters (alphabets) in figure-2 showed that means of these treatments are different from each other however similar characters showed similar means. The present work was supported by (Mohamed *et al.*, 2010) who worked on application of potassium fertilizer and found that it increases the growth of plant and hence increase the cured yield of tobacco.

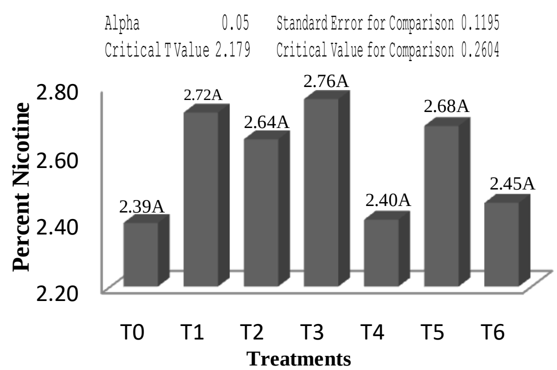

Figure 3: Effect of split application of Solo-potash on percent nicotine of K-399 variety

From figure-3, the range of nicotine contents was observed from 2.39% to 2.76%. Solo-potash split application showed significant variation in percent nicotine contents (P<0.05). Highest nicotine contents (2.76%) were observed in T_3 while lowest amount (2.39%) was found in T_0. Treatments means were separated using LSD test. Different characters showed that means of treatments are different from each other however similar characters revealed no difference among the means. The present data is also supported by Amirhendeh *et al.*, (2013) who worked on influence of rates and split application of potassium fertilizer on nutrient uptake and quality characteristics of Virginia (Flue-Cured) tobacco and observed significant variation in percent nicotine content by application by split dose of potassium fertilizer.

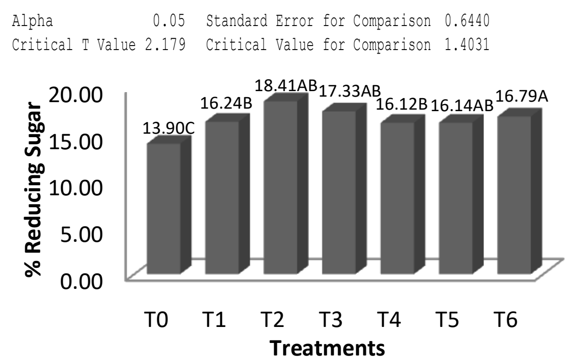

Figure 4: Effect of split application of Solo-potash on percent reducing sugar of K-399 variety

The effect of solo-potash on percent reducing sugar was found statistically significant (P<0.05). Figure-4 showed that reducing sugar contents ranges from 13.90% to 18.41%. The highest reducing sugar (18.41%) was observed in T_2 followed by T_3 (17.33%) while the lowest (13.90%) was noted in T_0. Means of treatments for reducing sugar were separated using LSD test. Different treatments means were separated using different characters. The data was supported by Amirhendeh *et al.*, (2013) who worked on influence of rates and split application of potassium fertilizer on nutrient uptake and quality characteristics of Virginia (Flue-Cured) tobacco and found the effect of different levels of potassium on reducing sugar of Virginia tobacco significantly different.

CONCLUSION

The following conclusions were drawn from the present research work:

Solo-potash split application increased the cured yield ($kgha^{-1}$) of Flue Cured Virginia Tobacco.
Effect of NPK fertilizer with split dose of solo-potash was found significant in percent reducing sugar, cured yield and percent nicotine of Flue Cured Virginia Tobacco.
Solo-potash application on leaf area (cm^2) was found non- significant

ACKNOWLEDGMENT

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Efficacy of Acid Hydrolysis for Various Agro-cellulosic Materials as a Feedstock for Ethanol Production

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ABSTRACT

The present study was carried out in vitro to determine the hydrolysis rate of agro-cellulosic wastes: Sorghum stalk, Wheat straw, Rice straw and Sugarcane Baggasse by different dilute acids with different time intervals (30, 60, 90-mints) by evaluating percent reducing sugar determined qualitatively by Fehling's test and quantitatively by refracto-meter in Brix^0. Average reducing sugar observed was ranging from: HNO_3(0.1N): (Sorghum stalk- 2 to 2.5, Wheat straw- 2 to 2.1, Rice straw- 1 to 2.2 and Sugarcane Baggasse- 2.5 to 3.12. HCl (0.1N): (Sorghum stalk- 1.85 to 2.5, Wheat straw - 1.9 to 2.4, Rice straw- 2 to 2.3 and Sugarcane Baggasse- 2.6 to 3.2. H_2SO_4 (0.1N): (Sorghum stalk - 1.9 to 2.3, Wheat straw - 0.75 to 1.7, Rice straw - 1.1 to 1.9 and Sugarcane Baggasse- 2 to 2.5 respectively. The data showed that hydrolysis efficiency of HCl was better among other acids under same dilute concentration. Reducing sugar content of Sugarcane Baggasse were more than the other agro-cellulosic stalks and straws. This study furnishes the way of economical chemical hydrolysis of reducing sugar, which then can be used for bio-ethanol production on commercial scale.

Keywords: Bio-fuel, Lignocellulosic biomass, Bio-ethanol, Chemical hydrolysis.

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INTRODUCTION

Cellulose and cellulosic materials are essential for man and animals. Major uses of cellulosic materials are in textile, paper and match-sticks industries and also as a food for animals. The agriculture cellulosic wastes have no such use and its decomposition occur in the fields or burned, which lead to environmental pollution and enhance global warming through formation of greenhouse gases (*Sun and Cheng, 2002*). Major components of Agro-cellulosic wastes are; cellulose (30-50%), hemi-cellulosic (20-35%) and lignin 25%, while the remaining part is oil, protein and ash (*Wyman 1994*). The most beautiful alternate is the bio-fuel, which can be obtained from a number of Ligno- cellulosic wastes such as; from agricultural wastes, forestry and municipal solid wastes (MSW) (*Wyman, 1996*). Bio-fuel mainly produced in two forms, bio-diesel and bio-petrol. Bio-petrol is primarily consisting of alcohol; mainly of ethanol. Ethyl alcohol production from Phyto-mass involves the physical breakage and grinding followed by hydrolysis and lastly fermentation (*Gerulova and Blinova, 2011*). Ethanol can be produced biologically at lower cost as compare to the present day prices of fossil or mineral fuel (*Wheals et al., 1999; Grad, 2006*). A lot of enzymes are required for its conversion to unit sugars and subsequently into ethanol (*Xeros and Christakopoulos 2009*). Cellulose can also be digested by the use of chemicals, in which dilute acids and bases solution are very important (*Galbe and Zacchi,* *2002*). Sweet sorghum can be used as feed stalk for ethyl alcohol production because of its high tolerance against hot and drought areas compared to other crops (*Almodares and Hadi, 2009*). The waste product of the sugar cane mills is the baggasse a complex material which contained about 50% cellulose, 25% hemi-cellulose and 25% lignin which can be used for bio-ethanol production (*Pandey et al. 2000*). Pakistan being an agriculture country has a great wealth of agriculture cellulosic wastes. If the methods of digestion are standardized and made economical, this will be the best source for bio-fuel production. Therefore, the present research work was geared around this objective. In which various dilute acids were used in same dilutions and combination to standardized hydrolysis method for good digestion of few very important Agro-cellulosic raw materials (rice straws, wheat straws, sugarcane baggass and sorghum stalk) available locally in great amount.

MATERALS AND METHODS

The research work was conducted at the Agricultural Chemistry lab, The Department of Agricultural Chemistry, The University of Agriculture, Peshawar, Pakistan.

PLANT MATERIALS

The Phyto-mass was collected from Rashaka area of Naoshehra District in Khyber Pukhtunkhwa and brought to the Department of Agricultural Chemistry, Peshawar. The samples used for hydrolysis were Sorghum stalk, Rice straw, Wheat straw and sugar-cane Baggasse.

SAMPLE PREPARATION

The Stalks and Straws were cut by stainless steel knife and placed in the oven for complete drying at 70 ^{0}C for two days. The dried samples were then powdered by grinder using 1mm mish. The powder of agro-cellulosic wastes was packed in plastic bottles.

ACID HYDROLYSIS

0.1N solutions of HCl, H_2SO_4 and HNO_3 were prepared in the volumetric flasks at room temperature and covered by aluminum foil. 3g of samples were weighted by digital balance and transferred to the digester tubes. 100ml of each acid were taken from the volumetric flasks by pipette and poured into the digester tubes. The tubes were then placed in the DK-20 Digester and set the digester time for 30 mints at temperature 200 ^{0}C. After hydrolysis the hydrolyzates were filtered and poured in the plastic bottle. The same procedure was repeated for 60 mints and 90 mints time interval. The hydrolyzates so obtained were then used for determination of reducing sugars qualitatively and quantitatively.

QUALITATIVE DETERMINATION OF REDUCING SUGAR IN HYDROLYZATES BY FEHLING'S TEST

Fehling's solution was used for qualitative analysis of reducing sugars in the hydrolyzates.

The appearance of color determined the proximate amount of reducing sugar in the hydrolyzates. The final color indicates that how much of reducing sugar is present. When the final color of solution is green; it gives the indication of <25% of reducing sugar is present. Yellow color indicates >25% and <50%, Red color indicates >50% and <75% and Brick red indicates >75% of reducing sugar is present in the solution. Fehling-A (34.65 gm of $CuSO_4.5H_2O$ in 500 ml of distilled water) solution (5mL) and Fehling-B (173gm of Sodium Pot.Tartrate and 50 gm of NaOH in 500ml of distilled water) solution (5 mL) were taken in conical flask and 20 mL of distilled water were added and then heated till boiling. The digested samples were taken in burette. The solution was added drop by drop in the conical flask till appearances of color.

QUANTITATIVE DETERMINATION OF REDUCING SUGAR IN HYDROLYZATES BY PORTABLE REFRACTIVE METER

Refractive meter was used for total soluble solids in a solution. The hydrolyzates were tested for glucose observation on refractive meter. The refractive meter was first calibrated by distal water and observed reading zero on $Brix^0$ scale and refractive index scale 1.33. The hydrolyzates two drops were then dropped on fixed prism and the line on the color scale was adjusted by fine knob. The readings on the $Brix^0$ scale were noted three times. The $Brix^0$ reading is almost equal to percentage of the sugar. (Rex Harrill method)

RESULTS AND DISCUSSION

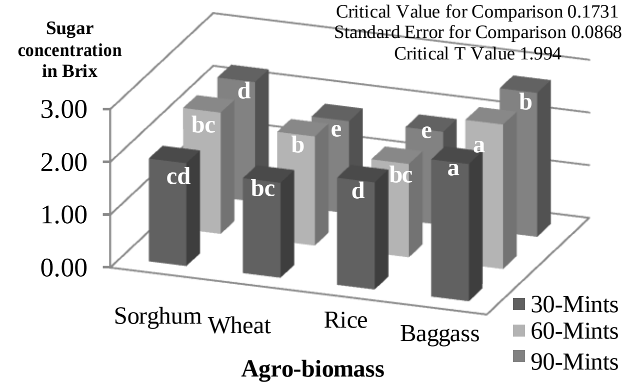

Figure.1: Comparison of Samples hydrolysis at different Time intervals.

Samples hydrolysis for reducing sugars was checked at different time intervals and reducing sugar amount were observed. Figure.1 showed that reducing sugars amount in sorghum stalk increases with increase of time duration. In case of wheat straw hydrolysis the more reducing sugar amount is observed at 60-Mints, similarly rice straw shoes same results, while sugarcane baggasse showed maximum amount of reducing sugars than other straws at all duration of time. Reducing sugar amount were more at 90-Mints of baggasse. Sugarcane baggasse, sorghum shows more sugar amount as time duration for hydrolysis increased, while the wheat straw and rice straw sugar content were recorded more at 60-mints time duration.

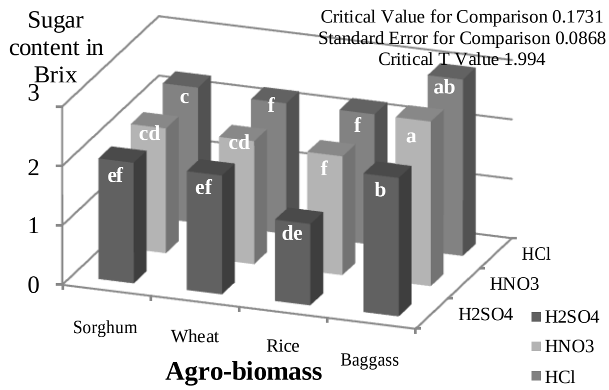

Figure.2: Comparison of Samples hydrolysis on different dilute acids.

Different dilute acids were treated to hydrolyzates to check the hydrolysis efficiency of each acid for reducing sugar. Figure.2 showed that HCl was more prominent acid for hydrolysis; the 2nd efficient acid is HNO_3 and H_2SO_4 showed less efficiency than other acids at 200^0C. The data obtained from the sorghum stalks hydrolyzate indicated that among the acid hydrolysis, Hydrochloric Acid was more prominent acid for hydrolysis. The amount of reducing sugar observed from HCl hydrolysis on sorghum stalk ranges from 1.85-2.50 $Brix^0$. Nitric Acid hydrolysis range was from 2.00-2.50 $Brix^0$. Sulphuric Acid hydrolysis ranges from 1.90-2.30 $Brix^0$. The amount of reducing sugar observed from HCl hydrolysis on wheat straw ranges from 1.9 to 2.4 $Brix^0$. Nitric Acid hydrolysis range was from 2 to 2.1 $Brix^0$. Sulphuric Acid hydrolysis ranges from - 0.75 to 1.7 $Brix^0$. The amount of reducing sugar observed from HCl hydrolysis on rice straw ranges from 2 to 2.3 $Brix^0$. Nitric Acid hydrolysis range was from 1 to 2.2 $Brix^0$. Sulphuric Acid hydrolysis ranges from - 1.1 to 1.9 $Brix^0$. The amount of reducing sugar observed from HCl hydrolysis on rice straw ranges from 2.6 to 3.2 $Brix^0$. Nitric Acid hydrolysis range was from 2.5 to 3.12 $Brix^0$. Sulphuric Acid hydrolysis ranges from - 2 to 2.5$Brix^0$.

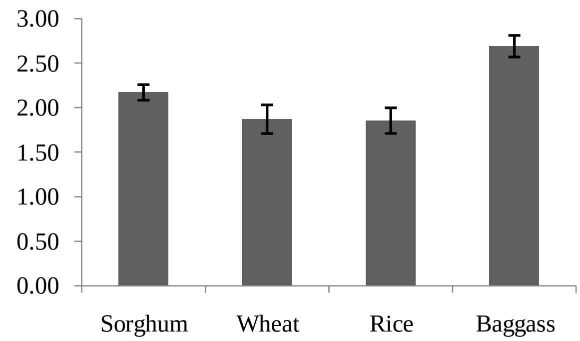

Figure.3: Comparison of Samples hydrolysis for total reducing sugars

Figure.3 showed that sugarcane baggasse has more reducing sugar than other straws the sorghum stalk also have more reducing sugar than wheat and rice straws, wheat straw has less amount of reducing sugar than baggasse and sorghum stalk but little more than rice straws. The overall results of all hydrolyzates showed that sugarcane Baggasse was more sugar content than others. Second more sugar content was of Sorghum stalks, third was Wheat straws and fourth one was Rice straws. While in case of acids HCl were more prominent than other acids for hydrolysis of agro-cellulosic wastes. And time effect also increased the hydrolysis, 60-90 Mints duration at 200^0C were more efficient for hydrolysis process.

The present data was in line with (Almodares and Hadi 2009), who studied Ligno-cellulosic digestion with acids and reported reducing sugar. The study of (Shi 2009) also supported the present data who studied different agricultural waste for cellulose digestion.

CONCLUSION

- Type of acids and time of digestion was important.
- It is recommended that mixture of acids, different dilutions and further time interval should be studied to further strengthen and standardized the process which makes it economical.

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COMPARISON OF SOME EXOTIC HYBRIDS OF FCV TOBACCO (*Nicotiana tobaccum* L.) GENOTYPES ON THE BASIS OF YIELD AND QUALITY ATTRIBUTE IN MANSEHRA, PAKISTAN

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ABSTRACT

An Experiment on comparison of some exotic hybrids of FCV tobacco genotypes was conducted at Baffa, District Mansehra during 2017-2018. The experiment was laid out in randomized complete block design (RCBD) replicated thrice with seven genotypes CC-143, CSC-4302, NC-938, CSC-4303, NC-925, CSC-4304, SPT.G.28. Ten parameters were studied including nicotine % and reducing sugar contents %. Mean squares from analysis of variance exhibited highly significant difference (<0.01) for all agronomic and biochemical traits; which indicated the genetic variability among genotypes; the tallest plants were measured in genotype NC 925, while the maximum numbers of leaves counted in genotype NC-938. Broader leaf area plant^{-1} was recorded in local check variety SPT.G. 28, while higher number of green leaves (kg^{-1}) recorded in candidate hybrid NC-925, moreover higher green leaves weight plot^{-1} was recorded in variety SPT.G.28. Higher numbers of cured leaves (kg^{-1}) were counted in variety SPT. G.28 and hybrid candidate genotype CSC-4302, respectively. local variety SPT.G 28 exhibited higher cured weight plot^{-1} as compared to rest hybrid genotypes as produced maximum yield ha^{-1}. Higher nicotine % recorded in hybrid CC-143 and local variety SPT.G 28 and the highest value for reducing sugar content reported in local variety SPT.G 28. It was recommended that genotype CC-143 NC-925 and CSC- 4304 possess desired traits, could be selected for further breeding program.

Keywords: Genotypes, agronomic traits, biochemical traits, nicotine %, reducing sugar content.

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INTRODUCTION

Tobacco (*Nicotina tobaccum* L.) is member of night shade or *Solanaceae* family. It is highly auto-gamous and short length cash crop (Wajahat *et al*, 2017). There are many genera of *Nicotina* harbacious plant and sherbs more than 70 species indigenously cultivated in America, Australia, South Africa and South pacific regions. But only two species of *N. tobaccum* L. and *N. rustica* L. are commercially cultivated for the production of cigarettes, cigars snuff and chewing type from cured/ dried tobacco leaves (Taj, 1994; Sheraz and Fida, 2017). Tobacco is considered as one of the major cash crop in Pakistan after Sugarcane and Sugar-beet, this crop generates more revenue as compared to other cash crops in our country. Tobacco was introduced in sub-continent in 16thcentury (Sheraz *et al*, 2014). It has been consumed as relaxing agent in Sub-Continent since long time (Ahmed, 1978). Tobacco plant parts are also being used as curing external skin diseases, swelling and curing for poisonous insects stings *etc*., tobacco leaves are used for making various homeopathic medicines, Few species of *Nicotina* are being used as ornamental purpose, for instance N. *sylvestris* and N. *alafa*, somehow it is also used as insect repellent but now a days this trend is reduced in modern age of chemical insecticides. Tobacco industry engages 11 million people in job directly or indirectly in Pakistan (Murtazain and Najabat, 2015). Approximately, 75000 growers are being cultivating tobacco in Pakistan, out of total 45000 growers belongs to KPK province. KPK is producing 95% of FCV tobacco on 25500 hectares mainly in five districts Mardan, Sawabi, Charsada, Mansehra, Swat and Buner. Tobacco sector is one of the main contributors to the government exchequer and provided 88 billion rupees in Federal Excise Duty/ sales tax in 2017-2018 (B. Recorder news 2019). It is important to be familiar about some quality and quantity attributed characters of tobacco like plant height, leaf area, number of leaves plant^{-1}, cured weight plot^{-1}, cured leaves kg^{-1}, cured leaf yield, nicotine content and reducing sugar % *etc*., (Woras *et al*, 1989). Low yield and better quality in tobacco is due to the lack of improved and high yielding varieties in country (Imtiaz *et al*, 2014) overcoming to this burning issue in the sector. Pakistan Tobacco Board and private companies are struggling to import hybrid cultivars from exotic sources.

Objectives of the study:

Comparison of different exotic FCV hybrids with local check varieties and to sort out healthy cultivars for the local region with better potential for higher production and to study the agro-morphological characteristics in FCV hybrid cultivars.

Materials and Methods:

Experiment was conducted at tobacco cultivating area Baffa District Mansehra, Pakistan. Experiment was laid out in randomized complete block design (RCBD) with three replication and 07 seven genotypes*i.e.*,CC-143, CSC-4302, NC-938, CSC-4303, NC-925, CSC-4304, SPT.G.28 were grown during 2017-18 growing season, distance between row to row and plant to plant were maintained as 90 x 60 cm. All cultural practices and fertilizers were applied as needed and kept under constant steady condition. Nursery was raised in mid of December 2017 and transplantation of seedlings was done in mid of March in 2018. Five picking of matured leaves were carried out during entire picking period.

Following agronomical parameters were studied in the experiment *i.e.*, Plant height (cm), leaf area (cm^2) number of leaves plant^{-1}, green weight plot^{-1}, green leaves Kg^{-1}, cured weight plot^{-1},cured leaves kg^{-1}, Cured yield hectare^{-1}, data was collected from 10 randomly selected plants from each variety and data was recorded as mean values. Two chemical compounds viz; nicotine % and reducing sugar content were examined in laboratory conditions. Nicotine percentage was analyzed using procedure by (Cundif and Murkunas, 1964) nicotine percentage calculated by using the following formula:

$$\textbf{Nicotine (\%)} = \frac{\textbf{V1xNx32.45x100}}{\textbf{Weight of the sample}}$$

Where;
V1= volume of titrant for non-Acetylated aliquot
N= Normality of per chloric acid

Reducing sugar content subjected to analysis in accordance with the method of Lane and Eynon (1923) and calculated by using the following formula:

$$\textbf{Reducing Sugar content} = \frac{\textbf{25x100x0.05}}{\textbf{Titrate x wt.of sample}}$$

Statistical Analysis of data

Data recorded on various agronomical and chemical traits were subjected to statistical analysis by using software Statistix (8.1) to determine significant difference through analysis of variance (ANOVA) method. The means were computed through Duncan's multiple range tests.

Results and Discussions:

All the agronomic parameters examined in the experiment were yield contributing traits which affect the tobacco yield directly or indirectly. Analysis of variance (ANOVA) exhibited highly significant at ($p<0.01$) differences for all examined parameters.

(i) Plant Height (cm): Plant height is an important character directly indicates towards the number of leaves coming out from a plant in tobacco therefore the plant height shows the potential number of leaves plant^{-1}the mean values for plant height ranges between (88.55 cm – 112 cm) in which the tallest plant was observed (112.17 cm) in genotype NC 925 while dwarf plant height measured (88.50 cm) in Genotype SPT G 28 (**Table: 1**). The phenotypic expression of hybrids might be environmental response or might be different genetically constitution of candidate genotype. Results for significant variation in plant height as same accordance with (Maleki *et al*. 2011; Shah et al. 2008; Sadeghi *et al*. 2012).

(ii) Number of Leaves plant^{-1}: It is an important yield contributing trait in tobacco crop leaf yield can be predicted after curing. Average figures observed for this trait were between (21.633-30.367) leaves plant^{-1}, the maximum numbers of leaves were counted (30.367) in genotype NC-938 on other hand minimum numbers of leaves counted (21.633) in genotype SPT .G.28 (**Table: 1**). These results are being resembled with (Butaroc *et al*. 2004 and Wajahat *et al*. 2017) they reported significant genetic variation in genotypes for number of leaves plant^{-1}.

TABLE 1: MORPHOLOGICAL ATTRIBUTES PERFORMANCE OF DIFFERENT TOBACCO GENOTYPES RECORDED DURING 2017-2018.

S.No	Genotype	PH	LP	LA	CLK	CWP
1	**CC-143**	100.45 CD	27.900 C	665.33 E	91.43 C	1.3700 D
2	**CSC-4302**	107.77 B	23.400 DE	593.33 F	**111.54 A**	1.1333 F
3	**NC- 938**	102.93 C	30.367 B	711.00 D	73.73 E	1.5533 C
4	**CSC-4303**	97.46 DE	18.500 F	750.67 C	101.29 B	1.1767 E
5	**NC-925**	**112.17 A**	24.433 D	750.67 C	80.11 D	1.6033 B
6	**CSC-4304**	94.30 E	**34.233 A**	785.33 B	68.61 F	1.6167 B
7	**SPT.G.28**	88.50 F	21.633 E	**854.87 A**	**111.54 A**	**1.8067 A**
LSD (0.05)		3.537	2.156	30.051	4.767	0.041

Means followed by different letters in each rows is significantly different at p> 0.05 level of probability followed by Duncan's multiple range test (DMRT)
PH =Plant Height, LP =Number of leaves plant^{-1}, LA = Leaf Area, CLK =Cured leaves kg^{-1} and CWP= Cured weight plot^{-1}

(iii) Leaf area plant^{-1}(cm^{-2}): This parameter is one of the major components for yield enhancing in tobacco. Mostly high prices are offered for long and broad leaves in the market. Mean values of data displayed by leaf area plant^{-1} ranged from (593.33 – 854.87 cm^{-2}). The broader leaf area plant^{-1}identified 854.87 cm^{-2}in local check variety SPT.G. 28 while narrow and short leaves plant^{-1} measured (593.33 cm^{-2}) in genotype CSC-4302 (**Table:1**). Results matched with the findings of (Ivica *et al*, 2011 and Butorac *et al*, 1995).

(iv) Number of Cured leaves kg^{-1}: It is important parameter through which yield potential can be determined. Cured leaves kg^{-1} ranges among the hybrids saved as (68.61-111.54 kg^{-1}). Higher number of cured leaves kg^{-1} counted as 111.54 and 111.54 kg^{-1} in variety SPT. G.28 and hybrid candidate genotype CSC-4302, respectively (**Table: 1**). While lowest cured leaves kg^{-1} noted at 68.61 in hybrid CSC-4303. The results are similar to (Wajahat *et al*, 2017; Rao *et al*, 1994 and Shah *et al*, 2008).

(v) Cured leaves weight plot^{-1} (kg): This parameter is directly related to the famers benefit; a final result comes out after various curing processes. Data for current experiment for cured weight plot^{-1} ranged from (1.1333 to 1.8067 kg). Local variety SPT.G 28 exhibited superiority for this most important trait followed by CSC-4302 with 1.333 cured leaves weight plot^{-1} kg. While results for NC- 925 and CSC-4304 were statistically similar (**Table: 1**). Current results are in agreement with (Dimitrova, 1998 and Hanoomanjee *et al*, 1998).

(vi) Number of Green leaves kg^{-1}: Green leaves kg^{-1}is another yield contributing parameter in tobacco through this cured leaves potential and affect in the cost of curing green leaf determined. Mean data manifested the green leaves kg^{-1} among the hybrids, ranges between (20.790--23.173) in which the lowest green leaveskg^{-1} were observed (20.790) in check variety SPT.G.28 while higher number of green leaves kg^{-1}recorded (39.567) in candidate hybrid NC-925 (**Table: 2**). Findings are in line with (Ahmed *et al*, 2014) they probed significant difference in all candidate hybrids in response to this parameter; it might be due to the different genetic formations of hybrids or variable climatic conditions.

TABLE 2: **MORPHOLOGICAL ATTRIBUTES PERFORMANCE OF DIFFERENT TOBACCO GENOTYPES RECORDED DURING 2017-2018**

S.No	GENOTYPES	GLK	GWP	CYH
1	**CC-143**	32.597B	4.027 F	2457.0 D
2	**CSC-4302**	30.677 C	6.377 D	2032.0 F
3	**NC- 938**	23.173 E	7.533 C	2785.7 C
4	**CSC-4303**	27.287 D	8.387 B	2110.0 E
5	**NC**	**39.567 A**	4.527 F	2875.0 B
6	**CSC-4304**	28.523 D	5.470 E	2899.0 B
7	**SPT.G.28**	20.790 F	**10.580 A**	**3240.0 A**
LSD (0.05)		1.769	0.752	75.030

Means followed by different letters in each rows are significantly different at p>0.05 level of probability followed by Duncan's multiple range test (DMRT).

*GWP=Green weight $plot^{-1}$, GLK=Green leaves kg^{-1}, CYH=Cured yield $hectare^{-1}$

(vii) Green leaves weight plot^{-1} (kg)

Results revealed a significant difference among FCV hybrids mean for green leaves weight plot^{-1}. Data for green leaves plot^{-1}varies from (4.027 – 10.580) kg plot^{-1}. Higher green leaves weight plot^{-1}was recorded (10.580 kg) for variety SPT.G.28 followed by (4.527 kg and 4.027 kg) in genotypes NC-925 and CC- 143 respectively. (**Table: 2**) These results are contrary to the results of (Dmitrova, 1998 and Liu *et al*, 1999) difference in results may be due to the variation in genetic material or influence of climatic conditions but are in agreement with (Butorac. *et al*, 2004) they found significant difference for leaf associated trait because different genetic materials.

(viii) Cured yield Hactare^{-1} (kg)

Yield is the final outcome of plant and straightforwardly related to the earning of farmer, higher outcome means higher benefits. Values of final trait ranged (3240.0 to 2032 ha^{-1}). Local check variety SPT.G.28 had produced maximum yield (3240 ha^{-1}) while minimum cured yield hactare^{-1} produced (2032 ha^{-1}) by hybrid genotype CSC-4302 (**Table: 2**). These results are in respect with highly significantly different in yield hactare^{-1} are alike with the study of (Sadeghi *et al*, 2012; Ivica *et al*, 2011 and Sheraz *et al*, 2014).

Biochemical Analysis

On basis of quality tobacco leaf in market, it is determined by chemical composition of the leaf. Higher percentage of nicotine in the leaf negatively affects to the smoker's physiology and extremely low nicotine percentage provide negligible level of satisfaction to the smoker.

Nicotine %

Nicotine percentage in hybrids ranged from (1.3900 – 3.5400 %). Higher nicotine % recorded 3.5400 in hybrid CC-143 and results of local variety SPT.G 28 were statistically similar to CC-143. Lowest nicotine % was determined 1.3900 in hybrid CSC 4303 (**Table: 3**). As reported by (Wajahat *et al*, 2017; Shah *et al*, 2008 and Triplat *et al*, 1994).

TABLE 3: BIOCHEMICAL ANALYSIS OF DIFFERENT TOBACCO GENOTYPES DURING 2017-2018

S.No	GENOTYPES	NICOTINE%	Reducing Sugars%
1	**CC-143**	**3.5400 A**	8.433 E
2	**CSC-4302**	2.8267 BC	9.500 DE
3	**NC- 938**	1.8500 DE	12.030 B
4	**CSC-4303**	1.3900 E	11.163 BC
5	**NC**	1.8333 DE	10.360 CD
6	**CSC-4304**	2.4600 CD	12.903 B
7	**SPT.G.28**	3.1467 AB	**14.670 A**
LSD (0.05)		0.682	1.118

Means followed by different letters in each rows are significantly different at p>0.05 level of probability followed by Duncan's multiple range test (DMRT).

Reducing Sugars Contents %

Tobacco taste and aroma depends on reducing sugar contents. That is assumed as one of the quality parameter in flue cured tobacco (FCV). Reducing sugar content in leaves of tobacco hybrids ranged between (8.433 - 14.670 %). The highest value for this parameter displayed 14.670 in local variety SPT.G 28 while lowest reducing sugar's value examined at 8.433 in hybrid variety CC-143, NC-938 and CSC-4304 manifested statistically same and showed superiority for reducing sugars content (**Table: 3**). These results are compatible as (Woras *et al*, 2004; Phatak *et al*, 1996 and Wajahat *et al*, 2017) according to their results significant genetic difference among genotypes found for reducing sugar (Anonymous 2005 and Steel *et al*, 1996).

Conclusion and Recommendations

It is keeping in view that better performance of the hybrids showed for agronomical and chemical attributions. In response to yield local variety SPT.G 28 proved better and produced higher yield whereas among the hybrids NC-925, NC- 925 and CC-4304 were proved healthy for agro climatic conditions of Mansehra and yielded satisfactory. Hybrid cultivar produces taller plants, more number of leaves plant^{-1}and more green leaves kg^{-1} and higher nicotine %. It is recommended that genotypes CC-143, NC-925 and CSC-4304 possesses good agro-chemical attributes so these genotypes should be selected for further breeding programs for agro-ecological conditions of Mansehra.

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Effect of Various Levels of Bio-gas Slurry on the Yield and Biochemical Constituents of *Nicotiana rustica* L. Tobacco

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ABSTRACT

A plot experiment was conducted in Tobacco Research Station, Khan-Garhi Mardan during 2017-18 to study the effect of various treatments of biogas slurry on the yield and biochemical composition of rustica-13 variety using randomize complete block deign (RCBD) layout with three replicates. The recorded data of agronomic and chemical parameters viz; plant height (cm), leaf area (cm^2), cured yield ($kgha^{-1}$), percent nicotine and percent reducing sugar contents showed significant variation ($p \leq 0.05$). Plant height ranged from 44.50 cm to 49.07 cm. Leaf area ranged from 382.53 cm^2 to 440.81 cm^2. Cured yield ranged from 1843 $kgha^{-1}$ to 2599 $kgha^{-1}$. Nicotine contents ranged from 2.09% to 2.72%. Reducing sugar contents ranged from 5.6% to 6.71%. Biogas slurry treatment (NPK:Biogas slurry, 200:1500 $kgha^{-1}$) showed best results among other treatments in biochemical properties of rustica-13 tobacco. Biogas slurry increases tobacco yield but for any commercial purpose the chemical properties of biogas slurry and bio-chemical properties of rustica should be considered.

Key words: Biogas Slurry, Rustica Tobacco.

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INTRODUCTION

Biogas slurry is a by-product of anaerobic digestion that produced from biogas plant (dung plant) and also produces biogas (combustible methane gas) that is used for cooking, lighting and running engines. Biogas slurry can be used to fertilize crops directly or added with other organic materials and synthetic fertilizers. Biogas slurry is considered a good source of organic fertilizer as it contains considerable amounts of both macro (N, P, K) and micronutrients (Zn, Mn, B) that are necessary for plant growth (Alam, 2006). Biogas slurry is basically used as fuel, fertilizer, and feed. Biogas can be economically converted to methane at facilities ranging from small holder utility equipments to large scale plants and therefore can be tailored to supply rural and urban gas needs as well as meet regional and nationwide energy demands.

Improvement of environmental conditions and public health as well as the need to reduce cost of fertilizing crops are also important reasons for advocating increased use of organic manures (Seifritz, 1982). Biogas production from agricultural biomass is of growing importance as it offers considerable environmental benefits and additional source of income for farmers (Amon *et al.,* 2007). During anaerobic decomposition, 25-30% of the total dry dung of animal is converted into a combustible gas and a residue of 70-75% of the total solids content of the fresh dung comes out as sludge which is known as biogas slurry (Gurung, 1998). Organic manures play a direct role in plant growth as a source of all necessary macro and micro nutrients in available forms during mineralization. Thereby, they improve both the physical and physiological properties of soil (El Shakweer *et al.*, 1998; Akanni, 2005), thus enhancing soil water holding capacity and aeration (Kingery *et al.*, 1993; Abouel-Magd *et al.*, 2005; Agbede *et al.*, 2008).

The bio-slurry generated from anaerobic decomposition of various organic matter contents is considered a good quality organic fertilizer (Islam, 2006). The bio-slurry contains high percentage of readily available nutrients thus can be applied directly to plants either liquid or solid for basal or top dressing (Mikled *et al.*, 1994). Bio-slurry has a potential to provide considerable amount of both macro and micro nutrients which are easily available than composted manure and farm yard manure besides appreciable amount of organic matter (Ishikawa *et al.*, 2006; Kumar *et al.*, 2016). The total nitrogen concentration of FYM can be up to 30% lower than in biogas slurry (Möller *et al.*, 2008). Bio-slurry is not only rich in mineral and organic dry matter, but also in nutrients like N, P, K, Ca, Mg, Fe, Mn, organic matter, different amino acids and metals like copper and zinc (De-Groot and Bogdanski, 2013). The slurry constitutes good quality manure free from weed seeds, foul smell and pathogens it also contains full range of micro and macro nutrients which are essentials to plants (Newar, 2008). If the bio-slurry is integrated well with chemical fertilizers at appropriate combination, it will lead to increased crop yield, quality produce like shapes and size and nutrient enhancement in the produce and ultimately reduce cost of farming through reduced dependence on expensive mineral fertilizer (Karki and Gurung, 1996; Jeptoo *et al.*, 2012; Shakeel, 2014).

Farmers use chemical fertilizers to increase crop production. However, this means that only mineral fertilizers are added to the soil, without organic manure and decreases soil productivity. If only organic manure is added, the desired crop yield increase may not be achieved either. Sometimes optimum crop yield and soil fertility levels can be achieved through the combination of chemical and organic fertilizers. However, chemical fertilizers are expensive and most small-scale farmers cannot afford them. The high costs involved make it essential for developing countries to find an alternative to chemical fertilizers. (Daiya and Vasudevan, 1985) In addition, „compared with chemical fertilizers, the biodegradation of organic matter in slurry is a slow process which is better for nutrient assimilation by the plant (Yu *et al.*, 2010). The yield of tobacco can increase by 13% with bio-slurry application (Gurung, 2001).

MATERIAL AND METHODS

An experimental trial was conducted to observe the effect of bio-gas slurry on yield and quality of Rustica tobacco in the year of 2017-18 under field conditions at Tobacco Research Station, Khan Garhi, Mardan. Biogas slurry was applied at various treatments with half dose of NPK fertilizer. Recommended dose of NPK was used as control treatment (T_0). Bio-gas slurry was applied before transplantation of seedlings in plots. Randomized complete block design (RCBD) layout with three replications was used. Row to row distance was kept 45cm while plant to plant distance was 30.48cm within row. Seedlings having 5-6 inches height with soil ball were transplanted to field. All approved cultural and agronomic practices were followed from transplantation till curing of leaves.

Agronomic and Chemical Parameters

Data of agronomic and chemical parameters viz; plant height (cm), leaf area (cm^2), cured yield ($kgha^{-1}$), percent nicotine and percent reducing sugar were noted from 10 randomly selected plants for every treatment in each replication. The details of the treatments are as under:

Treatments Codes	Treatments Kg/ha	
	NPK (60:60:90)	Bio-gas Slurry
T_0	400	0
T_1	200	500
T_2	200	1000
T_3	200	1500
T_4	200	2000
T_5	200	2500

Plant Height (cm): Plant height was taken from the ground level to the tip of the buds after topping in each treatment. Average height of 10 randomly selected plants was calculated for every replication.

Leaf Area (cm^2): Leaf area, length and breadth of 3rd, 5th and 8th leaf of 10 randomly selected plants were measured in each replication of every treatment and leaf area (cm^2) was calculated by using the following formula (Idrees and Khan, 2001):

$$\text{Leaf Area } (cm^2) = \text{Avg. length} \times \text{Avg. width} \times 0.644$$

Where 0.644 is the Correction Factor

Cured Yield ($kgha^{-1}$):

Cured leaves of every replication in each treatment were collected and counted. Cured leaves kg^{-1} were weighed on an electric scale and then the leaves were counted. All the cured leaves were weighed and the yield from one replication was converted into yield $ha^{-1}$for each replication in a treatment. Cured yieldha^{-1} of each treatment was calculated from average of three replication data (Idrees and Khan, 2001):

$$\text{Cured leaf yield (kg/ha)} = \frac{\text{Totalcured weight} \times 10000\text{m2}}{\text{Net area harvested}}$$

Nicotine Analysis (%): Leaf samples of every replication in each treatment were collected from randomly selected 10 plants and composite sample of half kg powered sample was made for percent nicotine contents. Nicotine content was calculated by the following formula as used by Idrees and Khan (2001):

$$\text{Nicotine content (\%)} = \frac{V1 \times N \times 32.45}{\text{Weight of sample}}$$

V_1 = Volume of titrant for non-alcholic aliquot

N = Normality of Perchloric acid

Reducing Sugar (%):

For reducing sugars analysis the same sample prepared for nicotine content were used and followed the procedure suggested by Lane and Eynon (1986).

$$\% \text{ Reducing Sugar} = 500 \text{ w x } 1000/\text{t. w } (100 - \text{m})$$

Where t = titration (solution A)

w = weight of tobacco.

m = percentage moisture content of tobacco

Statistical Analysis: All the above parameters were subjected to analysis of variance (ANOVA) technique using (Statistix® 8.1) software. Significant means were compared by using LSD test at $\alpha \leq 0.05$.

RESULTS AND DISCUSSION

The recorded data of agronomic and chemical parameters were analyzed statistically and results are presented in the given below figures.

Alpha 0.05 Standard Error for Comparison 0.0922
Critical T Value 2.228 Critical Value for Comparison 0.2055

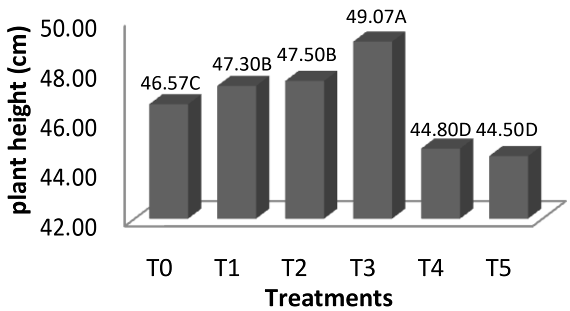

Figure 1: Effect of various treatments of bio-gas slurry on rustica plants height (cm)

Looking at figure-1, the effect of biogas slurry treatments on rustica plants height was found statistically significant ($P \leq 0.05$). Maximum height (49.07cm) was noted in treatment (T_3) and minimum (44.50cm) was observed in Treatment (T_5) however Plant height (46.57cm) was noted in control treatment (T_0). The means of treatments were separated using LSD test. The distinct characters (alphabets) showed significant variation in treatments means. All treatments means were found different from each other but treatments T_4 and T_5 were similar ($P \leq 0.05$). Ali *et al.,* (1984) also supported the present data and reported that plant height is important agronomic character in tobacco because plant height is directly related to yield and number of leaves on a plant. Hence plant height may be used as an indicator for high yield of tobacco.

Alpha 0.05 Standard Error for Comparison 6.2248
Critical T Value 2.228 Critical Value for Comparison 13.870

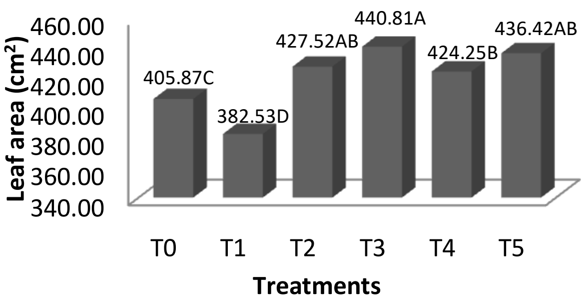

Figure 2: Effect of various treatments of bio-gas slurry on rustica leaf area (cm^2)

Effect of biogas slurry treatments from figure-2 showed that leaf area of plants leaves was significantly different ($P \leq 0.05$). Maximum leaf area (440.81cm^2) was observed in Treatment (T_3) and lowest (382.53 cm^2) was found in treatment (T_1) while leaf area (405.87 cm^2) was noted in control treatment (T_0). LSD test separated the different means using distinct characters while similar characters (figure-2) showed that treatments means are similar with each other. Woras *et al.,* (2004) reported that leaf area is one of the major yield components of a tobacco. Maximum leaf area indicates high yield. Shah *et al.,*(2008) also reported that usually high prices are offered for long and broad leaves of tobacco.

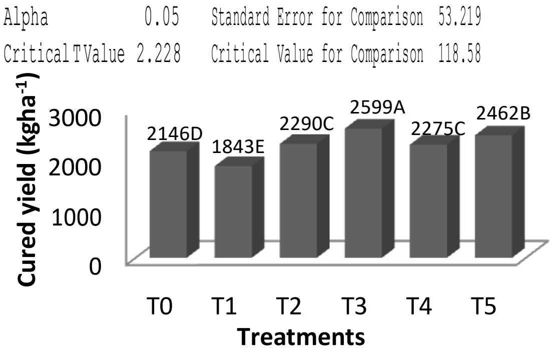

Figure3: Effect of various treatments of bio-gas slurry on rustica cured yield (kgha^{-1})

Looking at figure-3, highly significant variation was found in cured yield (kgha^{-1}) of rustica-13 ($P \leq 0.05$). Highest cured yield (2599 kgha^{-1}) was observed in treatment (T_3) and lowest (1843 kgha^{-1}) was found in treatment (T_1) however cured yield (2146 kgha^{-1}) was noted in control treatment (T_0). Means of data were separated by using LSD test. Similar characters (figure-3) showed that means were similar while different characters indicate variation in means of treatments. Ahmad *et al.,* (2014) reported that yield is the final important character of plant, which is directly associated with earnings of the growers. More yield means more profit of tobacco. Gurung, (2001) studied that the yield of tobacco can increase by 13% with use of bio-slurry.

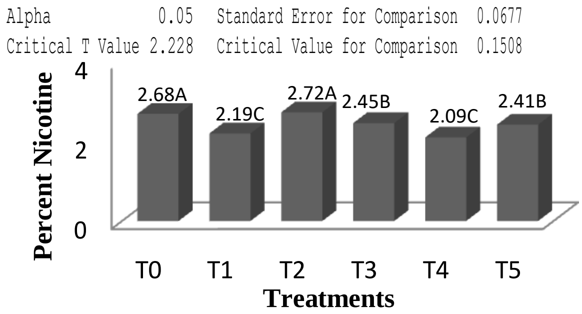

Figure 4: Effect of various treatments of bio-gas slurry on rustica (%) nicotine contents

Figure-4 showed that percent nicotine contents were found highly significant ($P \leq 0.05$). Percent nicotine ranges from 2.09% to 2.72%. Highest nicotine contents (2.72%) were observed in treatment (T_2) and lowest contents (2.09%) were observed in treatment (T_4). Treatments means were separated using LSD test. Distinct alphabets (characters) showed that treatments means are different from each other while similar characters showed no difference in treatments means.

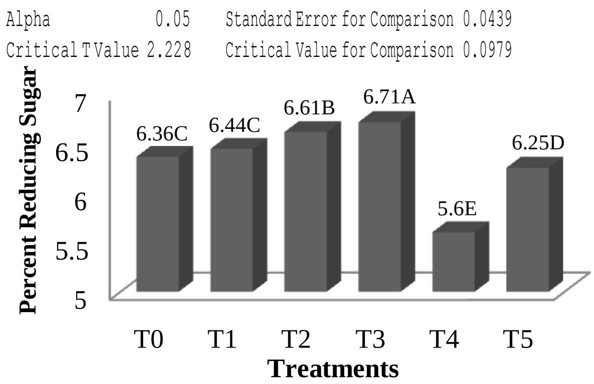

Figure 5: Effect of various treatments of bio-gas slurry on rustica (%) reducing sugar content

Looking at the figure-5, the effect of biogas slurry on percent reducing sugar was observedhighly significant ($P \leq 0.05$). Percent reducing sugar ranges from 5.6% to 6.71%.

Highest amount of reducing sugar (6.71%) was observed in treatment (T_3) and lowest (5.6%) was found in treatment (T_5).Means were separated using LSD test. Distinct characters showed means of treatments are different while similar characters showed similar means.

CONCLUSION

The following conclusions were drawn from the present research work:

Biogas slurry with half dose of synthetic NPK fertilizerin appropriate composition leads to increase the yield and quality of rustica tobacco. Effect of biogas slurry on agronomic and chemical parameters was found statistically significant. Bio gas slurry: NPK (1500kgha^{-1}:200 kgha^{-1}) was found best in yield, plant height, leaf area and percent reducing sugar contents

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EVALUATION OF VARIOUS INSECTICIDES FOR EFFICIENT CONTROL OF CUTWORM IN DARK AIR CURED TOBACCO

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Muhammad Atif*, Dr Hafiz Abdul Samad Tahir*

ABSTRACT

Effectiveness of various chemical pesticides for control of Cutworm on the Dark Air Cured Tobacco crop was evaluated at Tobacco Research Sub-Station, Kunjah, Gujrat, Pakistan. Experiment comprised of 5 treatments followed Randomized Complete Block Design (RCBD) with 4 replications. Treatments includes Karatay, Emamectin, Talstar, Chlorpyriphos and control/no application. Results revealed that Talstar performed better as compared to the other treatments while pairwise comparison showed that Talstar and Karatay were expressing statistically non-significant difference with each other but significant difference as compared to the all other treatments and all the treatment (pesticides) showed significant difference from the control.

Key words: Tobacco, Cutworm, Insecticide, Talstar, Karatay, Emamectin, Chlorpyriphos.

***Pakistan Tobacco Board**

INTRODUCTION

Tobacco *(Nicotiana Tabaccum)* is an important crop which belongs to the genus *Nicotiana* of *Solanaceae* family. It is a tall, succulent, green leafy plant which was originated from Americas and had wide spread use in its native cultures. After discovery and exploration of the continent it spread to whole of the world along with Potato and is now grown in almost all kinds of environments around the world. It has gained a status of an important cash crop of agricultural societies throughout the world and offers high and reliable income. In Pakistan Tobacco is grown on only 0.25 % cultivable area of Pakistan and only 1.2 million people are directly or indirectly related to the farming, manufacturing, distribution and retailing of the crop or products. But these small statistics does not do justice to its importance as tobacco sector is among one of the main contributors to the country income and contributed more than 3% to annual GDP of country in fiscal year 2015-16 (Statistical division, 2016). It has a high yield potential in Pakistan but insect pests are among the most important factors hurting its yields and quality in the country. Numerous insect species have been described by the scientific community which cause severe damage to tobacco right from the start at nursery level to curing barns and sheds, in the form of attack on roots, destruction of leaves and buds, reduction of leaf quality and transmission of some harmful plant diseases and viruses.

The tobacco Cutworm (*Spodoptera litura)*is among the most common and damaging insects of Tobacco and is found abundantly throughout all the tobacco growing areas of Pakistan and South Asia. It has tendency to cause serious harm to the crop and even reducing the yield completely if not managed and controlled properly and timely. Bagwell *et al.,* 1998 and Payne *et al.,* 1999 reported its highly troublesome nature due to its development and adoption of insecticide resistance to different insecticides at different level. A variety of plants are considered as its host but most important ones are tobacco, cotton, soybean, beet, cabbage, and chickpeas (Khan, 1976). It attacks right after the transplantation of seedlings and cut of newly set plants just above the soil surface and occasionally cut off individual leaves, hence the name. *S. litura* cause severe damage to their hosts by their vicious eating habits as larvae. When the host plant in a particular area is depleted, big groups of larvae will migrate to find a new food source (Abbas *et al.,* 2012). Cutworms are usually active at night or on cloudy days. During the day time they hide beneath the soil surface at the base of freshly cut plants or under soil clods and vegetative debris. Cutworm problems are not easy to predict; however, cutworms are most likely to occur in weedy fields (Ahmad *et al.,* 2009). Quality of the cured tobacco leaves is utterly damaged by the attack of *S. litura* and crop fetches low market value and ultimately the farmers face massive economic losses (Patil & Chari, 1977). Various control procedures are implemented to reduce crop damages caused by this pest (Kharboutli *et al.,* 1999). Pesticides play main role keeping in check the attack of Cutworm and a whole range of pesticides are available in the market for its efficient control. Large scale cultivation of the tobacco crop with solitary addiction on insecticides has established resistance of the chemicals in the pest. Widespread use of artificial pyrethroids on tobacco and other crops, against cutwormhas become resistant at several locations in the world (Dhingra *et al.,* 1988 and Armes *et al.,* 1992). Objective of this study is to develop an efficient management strategy for the chemical control of tobacco cutworm by evaluation and comparison of various insecticides.

MATERIALS AND METHODS

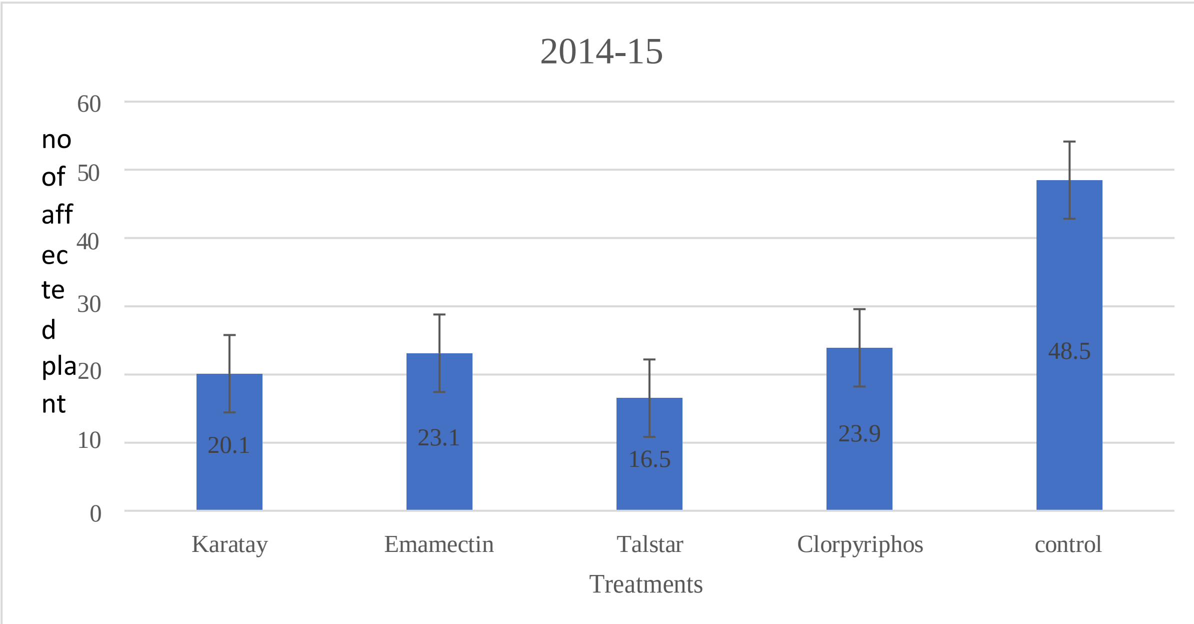
A research trial to check the efficacy of various chemical pesticides to manage the attack of cutworm on the DAC crop was conducted at Tobacco Research Sub-Station, Kunjah, Gujrat during the crop year 2014-15 and was repeated in crop year 2015-16 for verification of the results. Tobacco seedlings were transplanted in the last fortnight of February of each year. Plants were planted while maintaining plant to plant and row to row distance of 2 feet and 3 feet respectively. Following five treatments were applied while using Randomized Complete Block Design at the prescribed rate and 4 replications/blocks of each treatment were laid to cross check the effectiveness of the treatment against the un-applied/un-treated control.

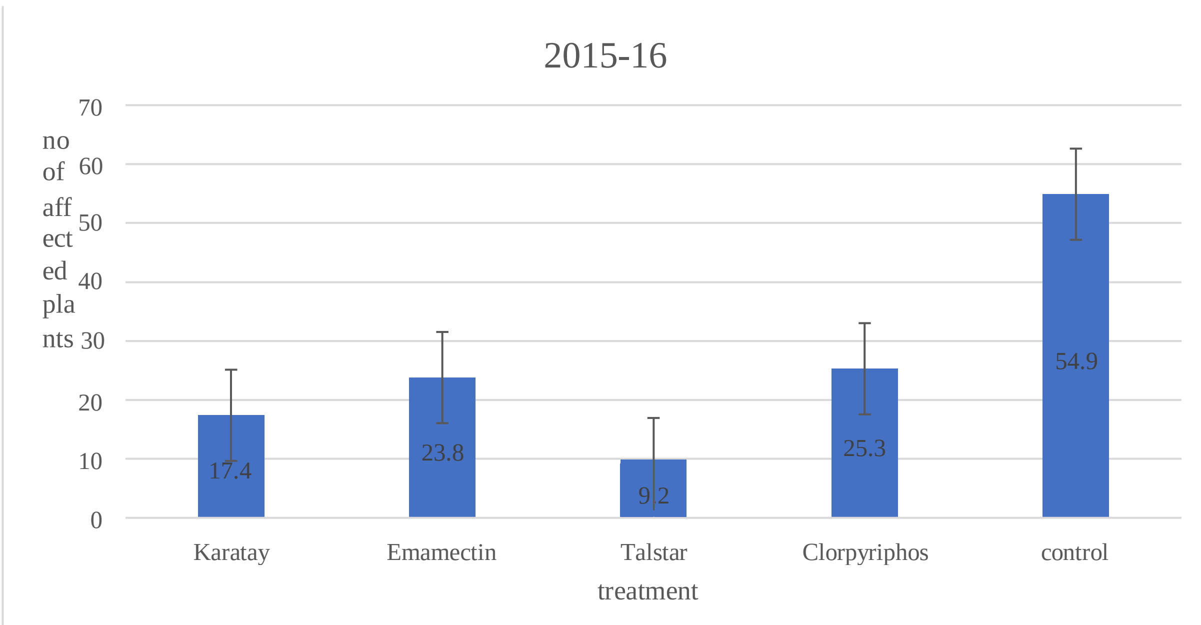
S. No.	Treatments	Active Ingredient
1	Karatay @ recommended dose	Lambda cyhalothrin
2	Emamectin @ recommended dose	Emamectin benzoate
3	Talstar @ recommended dose	Bifenthrin
4	Chlorpyrifos @ recommended dose	Chlorpyrifos
5	Control	No Application

Preventive dose of the pesticides was applied to the plants and after 5 days pest scouting was done to check the number of pests affected plants. Collected data was subjected to the statistical analysis using Computer based statistical package (Statistix® 8.1) based on Steel and Torrie (1980). Significant means were compared using LSD test at $\alpha < 0.05$.

Results and Discussion

Collected data was subjected to the statistical analysis which showed that the in the year 2015 crop, treatment 3(Talstar) performed best as compared to the other treatments while pairwise comparison showed that treatment Talstar and Karatay were showing statistically nonsignificant difference among each other while statistically significant difference was noted between these two treatments and all other treatments and all the treatment (pesticides) showed significant difference from the control. While in year 2016 crop all treatments were showing significant difference with control.


2014-15
no of affected plant
60
50
40
30
20
10
0
20.1
23.1
16.5
23.9
48.5
Karatay
Emamectin
Talstar
Clorpyriphos
control
Treatments


2015-16
no of affected plants
70
60
50
40
30
20
10
0
17.4
23.8
9.2
25.3
54.9
Karatay
Emamectin
Talstar
Clorpyriphos
control
treatment

All four insecticides significantly reduced the number of attacked plants in both years as compared to control. Results express that the Talstar performed best in effectively controlling the cutworm attack on plants with only 16.5 % attacked plants in 2015 and 9.2% attacked plants in 2016 followed by Karatay (20.1 and 17.4%), Emamectin (23.1 and 23.8%) and Clorpyriphos (23.9% and 25.3%) while un-treated Control had 48.5 and 54.9% attacked plantsin 2015 and 2016 respectively. Pre-treatment observations recorded for all the plots were found significantly different.

The yields of tobacco in Pakistan are high than the global average yields but its quality is inferior as compared to other top tobacco producing countries (Badshah, 2005). Insect pests are one of the main reasons of this low-quality tobacco, especially the cutworm (Patil & Chari, 1977). The cutworm can inflict losses up to 11.35% in tobacco fields, (Aslam *et al.,* 1980; Patil, 1977). Our results showed a significant reduction in number of attacked plants. Chemical treatment proved to be statistically significant in both crop years (2015 & 2016). Minimum numbers of attacked plants were observed due to insecticide application. Talstar insecticide can be a better and economical option for the efficient management and control of Tobacco cutworm as compared to the other three insecticides in Gujrat area.

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EVALUATION OF FUNGICIDES AGAINTS DAMPING OFF DISEASE IN TOBACCO SEEDLINGS

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ABSTRACT

The damping off disease is becoming a serious threat for tobacco growing areas worldwide. Studies were conducted on the efficacy of different fungicides (Ridomil Gold, Dithane, Acrobate and Antracol) for the management of soil borne diseases on tobacco crop at Pakistan Tobacco Research Station, Khan Garhi Mardan during 2015-2018. Results revealed that Ridomil Gold and Dithane were more effective with disease incidence (0.66 %) followed by Acrobateand Antracol (1.00 %) during the year 2015-2016. In the year 2016-2017, Ridomil Gold and Antracolwere displayed the most effective results, reducing the disease incidence (0.33%) relative to Dithane and Acrobate 0.66 % in tobacco seed bed. During 2017-2018, the less disease incidence (0.66 %) was observed in seed beds treated with Ridomil Gold as compared to beds treated with Antracol, Dithaneand Acrobate. Thus, Ridomil Gold proved to be more effective in reducing the incidence of damping off disease in tobacco seed bed.

Key words: Tobacco, Fungicide, KPK, Diseases, damping off

INTRODUCTION

Tobacco (*Nicotiana tabacum*) is a prominent cash crop and major source of income for farmers in Pakistan. Before independence of Pakistan, *N.tabacum*was grown in Khyber PakhtunKhwa, Punjab and Sindh for local consumption in hukka, snuff and biddies. In Pakistan area under tobacco cultivation is 47 hectares with a production of 100 Tonnes, Pakistan Bureau of Statistics. (MINFAL, 2017-2018).

In the field seedlings often fail to come up or die soon after they have emerged from the soil. Seed may rot before they germinate, shoots may be decayed before they emerge or stems of seedling may be attacked near the soil line causing young plants to collapse. These diseases often are collectedly referred to as "damping off" and may be caused by several soil inhabiting pathogens. *Pythium* sp. is most responsible for damping off, but several other pathogens including species of *Rhizoctonia*sp., *Fusarium* sp., and *Phytophthora*sp. may also cause decay. *Pythium* disease of field crop is considered as an important limiting factor in successful cultivation of crop plants throughout the world. It is estimated that disease caused by *Phythium* sp. in different crops are responsible for losses of multibillion dollars worldwide (Van-west *et al*., 2003). Estimated losses due to this pathogen in the production of tobacco seedling in North Carolina were about 0.5% in 1993 and 1994 (Melton *et al*., 1995). The genus Pythium is one of the largest oomycete genus and consist of more than 130 recognized species which are isolated from different regions of the world (De-Cock and Levesque, 2004; Paul *et al*., 2006; Bala *etal*., 2010; Robideau *et al*., 2011).

Rapid germination of sporangia of *Pythium* pathogens after exposure to exudates or volatiles from seeds or roots (Osburn *etal*., 1989; Fakui *etal*., 1994) followed by immediate infection make management of *Pythium* very difficult (Whipps and Lumsden, 1991). Many plant extracts inhibit spore germination and mycelial growth of pathogenic fungi and found significant as pesticides. Leaf extract of *Zimmu* was also reported to be effective against *Phythium* under *vivo* condition (Mitali *et al*., 2012; Zagade *et al*., 2012). Keeping in view the importance of tobacco damping off problem the object of this study was "*in-vivo* evaluation of effective fungicide against tobacco damping off".

MATERIALS AND METHODS

A field experiment was conducted at Tobacco Research Station, Khan Garhi Mardan during the year 2015-2018 to study the effect of different fungicides in controlling tobacco damping off disease. The field where severe attack of damping off was observed in the previous year was selected for the experiment. This experiment was laid out in Randomized Complete Block (RCB) design with 3 replications.

A Susceptible Variety of Flue Cured Virginia (FCV) i.e., SPT-G-28 was planted on raised beds having size of $1m^2$ and 7.5 cm apart. A set of fungicides (table no. 1) were applied according to their recommended doses. An unamended control treatment was also set out in the experiment. The fungicides were applied after 75% seed germination of tobacco as foliage spray. A small hand operated pressure sprayer was used for fungicides application and a uniform coverage to foliage was given to each sub plot.

Table 1: List of tested fungicides against damping off disease in FCV tobacco

Fungicide	Recommended Dose
Ridomil Gold	4g/L.H_2O/m^2
Dithane	4g/L. H_2O/m^2
Acrobate	4g/L. H_2O/m^2
Antracol	4g/L. H_2O/m^2

The weakening of the stems near soil surface, poor plant stand disease area in the form of patches the pale color of seedling and stunted growth were taken as criteria for recording observations. The disease patches were measured for determining the effectiveness of fungicides.

Disease incidence was recorded using the following formula,

$$\%\ disease\ incidence = \frac{No.of\ disease\ plants}{\text{Total no. of plants}} \times 100$$

The data was subjected to Statistix 8.1 for further analysis using RCB design. Means were separated by LSD when they showed significant difference ($P \leq 0.05$).

RESULTS AND DISCUSSIONS

To check the performance of four different fungicides, % disease incidence was estimated and for analysis of variance RCB design was used. Through the ANOVA, a highly significant (P=0.0000) effect of fungicides was noted, in the year of 2015-2016 (Figure2). Mean of % disease incidence ranged from 0.66 to 7.66 were noticed. Ridomil Gold and dithane were effective with 0.66 % disease incidence followed by Antracol and Acobate 1.00 % disease incidence. However, the maximum value of 7.66% disease incidence was observed in control.

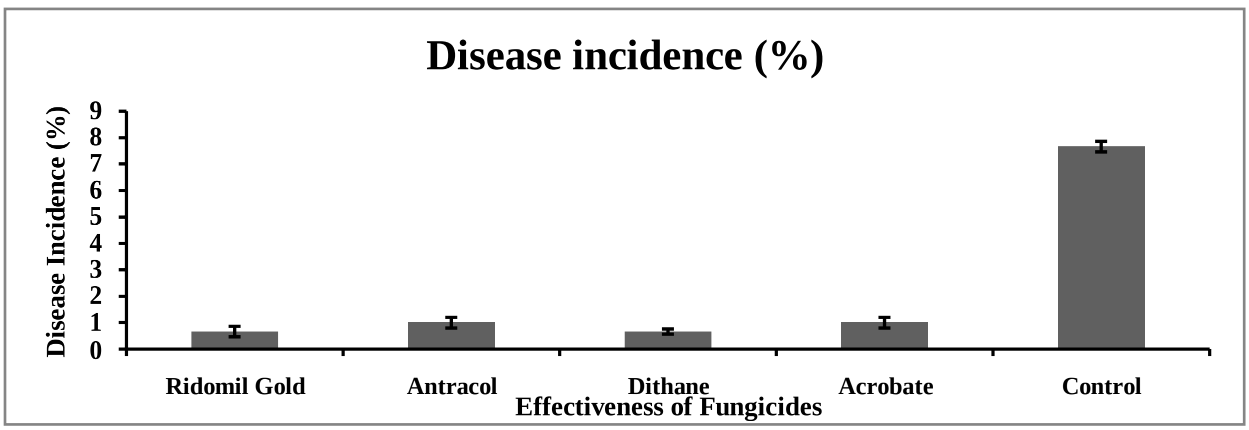

Figure 2: Evaluation of different fungicides against tobacco damping off disease in seed bed during 2015-2016.

In the next year 2016-2017, the effect of fungicides was noticed in (Figure 3). Mean of disease incidence ranged from 0.33 to 5.00 % were noticed. Ridomil Gold and Antarcol were effective with 0.33% disease incidence followed by Dithane and Acrobate (0.66 % DI). The maximum value of 5.00 % DI was observed in control.

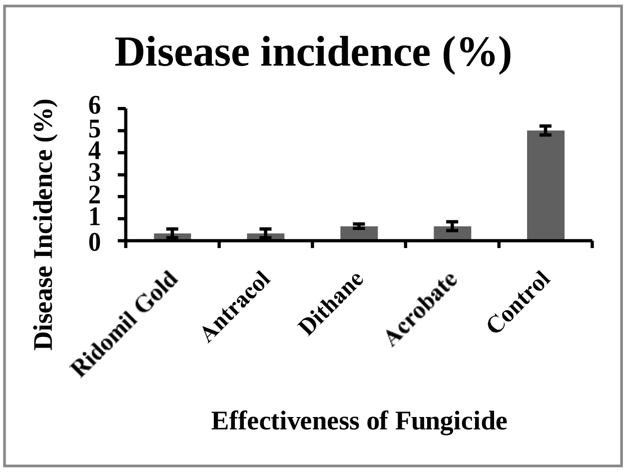

Figure 3: Evaluation of different fungicides against tobacco damping off disease in seed bed during 2016-2017.

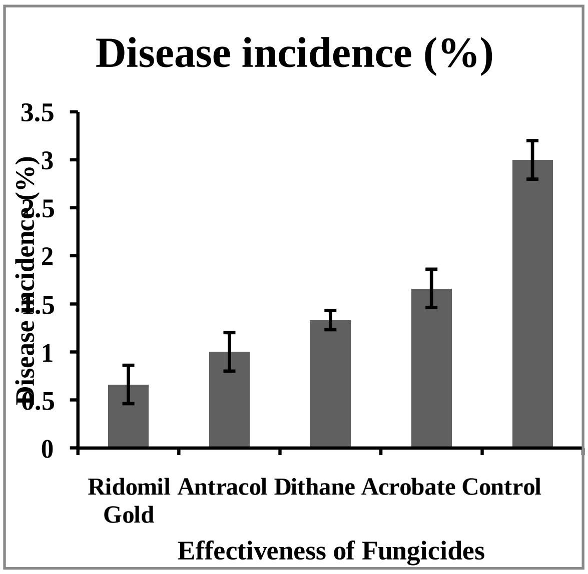

Figure4: Evaluation of different fungicides against tobacco damping off disease in seed bed during 2017-2018.

In the next year 2017-2018, the effect of fungicides was noted in (Figure 4). Mean of disease incidence ranged from 0.66 to 3.00 % were noticed. Ridomil Gold 0.66 %DI and Antarcol 1.00% DI were effective disease incidence followed by Dithane 1.33 %DI and Acrobate (01.66% DI). The maximum value of 3.00 % DI was observed in control.

Palakshappa *et al*., (2010) reported the performance of three fungicides viz, Metalaxyl, Mancozeb and Ridomil MZ in field nursery experiment conducted during kharif (2006 and 2007).The pooled analysis revealed the significant difference among the fungicides.

CONCLUSION AND RECOMMENDATION

The result of present research work indicated that the use of fungicide against tobacco Damping off disease was effective as compare to control. Adequate resistance to disease by Ridomil Gold and Dithane is due to the presence of active ingredients. The studies for fungicides screening against tobacco damping off should be extended to more location of Khyber PakhtunKhwa and Pakistan as part of a systematic tobacco disease resistance program.

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Efficacy of Various Insecticides for the Control of Tobacco Budworm *(Heliothis virescens)*

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ABSTRACT

Response of Budworm towards three insecticides i.e. Belt, Reagent and Pirate were evaluated at Tobacco Research Sub Station (TRSS) Okara(Punjab), using the randomized complete Block design (RCBD) with three replicationson Dark Air Cured Tobacco (DAC) using Gulpao variety. All the treated insecticides had significant effect in reducing the Budworm attack as compared to the control. However, Belt was found the most effective for reducing the pest population as compared to the other insecticides.

Key words: Insecticide, Tobacco, Budworm, Dark Air Cured

INTRODUCTION

Tobacco is a tall green leafy annual plant of warm climate, originated from South and Central America, but now cultivated throughout the world, covering a range of approximately 100 countries. Being a cash crop, it is an important and reliable income source that has contributed to increase farmers welfare. In Pakistan, tobacco is a major source of revenue, employment, foreign exchange and cultivated on approximately 51.3 thousand hectares with production of 102.8 thousand tonnes (Anon., 2011). Almost 1.5 million people of Pakistan directly or indirectly linked to the tobacco crop from the growing of the tobacco to the cigarette manufacturing. It provides a higher income than any other crop to small land holders. Insect pests are one of the most important factors that are responsible for poor quality of tobacco. Several insect species are reported to cause serious damage to tobacco starting from seed beds to curing barns in the form of attack on roots, destruction of leaves and buds, reduction of leaf quality and transmission of several important plant diseases.

The tobacco budworm (*Heliothis virescens)* is one of the most common devastating insects of Tobacco and is found throughout the tobacco growing areas of Pakistan. It can heavily damage the crop if not controlled properly. It is an especially troubling pest because of its ability to develop resistance to insecticides (Bagwell*et al.*, 1998; Payne *et al.*, 1999). Its attack on tobacco, potato, tomato, bottle gourd, okra, cabbage, sugar beet, turnips, grams and many ornamental plants at different times of the yearand different localities were also recorded by Khan

(1976). Budworm attack starts after the transplantation and mostly the emerging leaves are affected by this insect. The larvae of the second generation eat into the seedpod and on the suckers (Hussain *et al.,* 1979). Larvae bore into buds and blossoms (the basis for the common name of this insect), and sometimes the tender terminal foliar growth, leaf petioles, and stalks. In the absence of reproductive tissue, larvae feed readily on foliar tissue. Neunzig, (1969). Quality of the tobacco leaves are heavily affected due to the attack of budworm that fetches low market price and eventually the growers face enormous financial losses (Patil & Chari, 1977). Various control measures are used to minimize crop losses caused by this pest (Kharboutli *et al.,* 1999). Insecticides play a major role in controlling the attack of this insect and different insecticides are available in the market for the control of this insect. The use of foliar insecticides for the budworm control is a common and reliable source. Cultivation of the crop in large areas with a sole dependence on insecticides at various doses leads to development of resistance to the pest. Extensive use of synthetic pyrethroids on tobaccoagainst bud worm has become resistant at several locations in the country (Dhingra *et al.,* 1988 and Armes*et al.,* 1992). Also resistance to insecticides is widespread particularly in crops where parathyroid use is frequent (Kanga et al. 1995, Greenstone 1995). Hazards and harmful effects of insecticides as chemical control especially the wide application of conventional insecticides necessitate the new chemistry insecticides which are more effective, safer for humans and much less toxic to our ecosystem (Korrat et al., 2012).

With the passage of time, new chemistry is being introducing in the market to break the resistance of insects against the pesticide of old chemistry. Therefore, the present study is an attempt to develop an effective management strategy for the control of tobacco budworm by evaluating the efficacy of different new insecticides.

MATERIALS AND METHODS

Efficacy of different insecticides; Belt, Reagent and Piratewas tested against the tobacco budworm. A field experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The trial was conducted at Tobacco research sub-station okara (Punjab). Galpao variety of DAC Tobaccowas used during the crop year 2014 and 2015. Plants were sprayed using manually operated spray machine. Number of attacked plants (%) and Population of larvae were recorded one day before the 1st spray and then after three, six and nine days of the application of the spray. The control plots were sprayed with water only. The data of each experiment was analyzed statistically by using analysis of variance (ANOVA), followed by Tukey's honestly significant difference (HSD) multiple range test (P≤0.05) using the SPSS software (SPSS, Chicago, IL).

Table 1: Treatments detail and their doses per acre

Sr. No.	Insecticides	Common Name	Dose
1	Belt	Flubendiamide	50 ml/Ac
2	Reagent	Fipronil	30 gm/Ac
3	Pirate	Chlorphenapyr	100 ml/Ac
4	Control	--	--

Results and Discussion

All three insecticides significantly reduced the number of attacked plant as well as number of larvae per plant, as compared to control in both years. Results showed Belt found the most effective insecticide among all, with only 3.11 % attacked plants in 2014 and 2.96% in 2015 followed by pirate (5.77 and 9.60%) and reagent (4.93 and 5.92%), while non sprayed, control had 11.55 and 25.9% attacked plants in 2014 and 2015, respectively. Similarly, all the insecticides reduced the number of larvae per plant, when observed after three, six and nine days of insecticide application as compared to pre spray data and non-sprayed control. Belt and Pirate reduced the number of larvae per plat up to, almost zero after nine days of spray and showed non-significant results between two treatments. It was observed that number of larvae per plant in sprayed plots continued to be decrease with the passage of time and in control treatment continued to be increase. Pre-treatment observations recorded for all the plots were found non-significant.

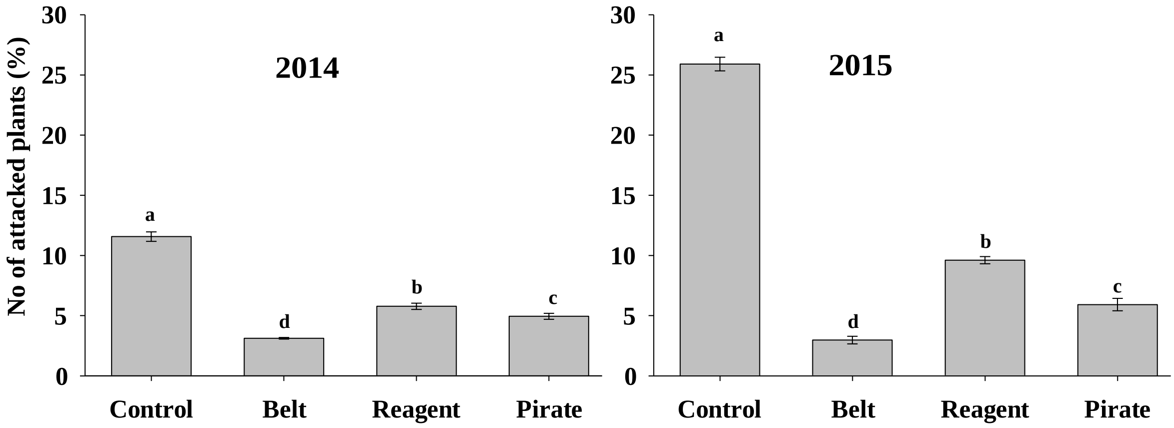

Fig1. Mean %age of number of attacked plant by budworm (*H. virescens)*
Error bars indicate standard deviations of the means. Different letters above error bars represent significant differences according to Tukey's honestly significant difference (HSD) multiple range test (P≤0.05) using the SPSS software (SPSS, Chicago, IL).

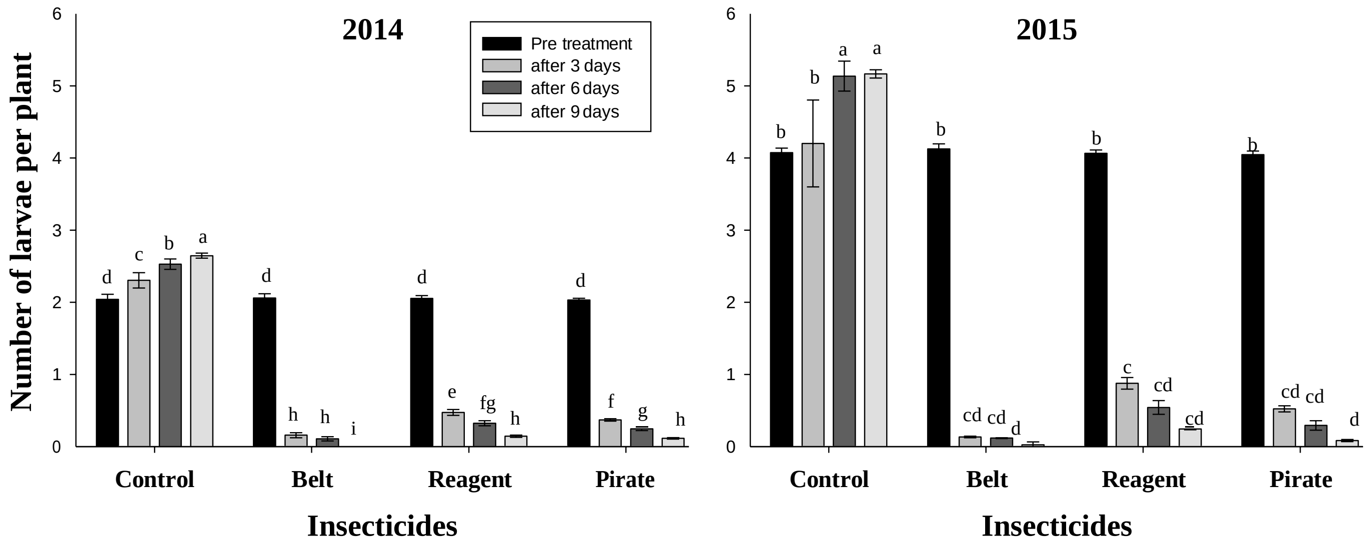

Fig2. Mean larval number per plant of budworm (*H. virescens*) at pre and post spray intervals of application of insecticides.
Error bars indicate standard deviations of the means. Different letters above error bars represent significant differences according to Tukey's honestly significant difference (HSD) multiple range test (P≤0.05) using the SPSS software (SPSS, Chicago, IL).

The production of tobacco is superior in Pakistan but its quality is inferior as compared to other tobacco producing countries (Badshah, 2005). Insect pests are one of the main reasons of this low quality, especially the budworm (Patil & Chari, 1977). The budworm (*Heliothisvirescens*) inflicted losses up to 11.35% in tobacco fields, (Aslam *et al.*, 1982; Patil, 1977). Our results showed a significant reduction in number of attacked plants and number of larvae. Treatment effect was statistically significant in both the years (2014 & 2015). Minimum numbers of attacked plants were observed due to insecticide application. The highest budworm population was observed in control which was (11.55 and 25.9%) while the lowest attack was recorded for the plots treated with Belt (3.11 and 2.96 %) in the year 2014 and 2015, respectively as shown in Table II. The lowest attacked plants were observed for the both seasons 2014 and 2015 in the plots treated with Belt (3.04%) followed by Pirate (5.43%) and then Reagent (7.68%) as compared to control where no insecticide was used. Belt insecticide can be a better competitor for the management of Tobacco budworm as compared to the other two insecticides. It was observed that budworm population was increased in the control plot where no insecticide was used. Our results are in conformity with previously reported results. Tohnishi *et al*., (2005) reported Flubendiamide (active ingredient of Belt) as a novel insecticide against Lepidopterous Insects (Tohnishi *et al*., 2005).

Conclusion

From the whole experiment it can be concluded that Belt insecticide is more effective than the other two insecticides. Moreover, timely spray is most important for the control of this insect and the most appropriate application time is the time when 10% plants infested with larvae.

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Evaluation of Heavy Metals in Tobacco Cultivars Grown in Mardan Area, Pakistan

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ABSTRACT

The present study was carried out in vitro to evaluate the heavy metal contents in different tobacco cultivars. Leaf samples of Flue Cured Virginia varieties (K-399 and Speight-G-28) and Rustica (Rustica Swabi and Rustica-14) were analyzed for heavy metals at Tobacco Research Station, Khan Garhi Mardan during 2018. Tobacco varieties were found significantly different in heavy metals concentration ($P \leq 0.05$). The means were separated using LSD test. Nickel (Ni) contents ranged from 2.15ug/g in K-399 to 3.67ug/g in Rustica-14. Chromium (Cr) contents ranged from 1.23ug/g in Speight-G-28 to 2.43ug/g in Rustica-14. Lead (Pb) contents ranged from 0.69ug/g in Rustica Swabi to 1.29ug/g in K-399. Cadmium (Cd) ranged from 0.12ug/g in K-399 to 0.36ug/g in Rustica-14. Results showed that rustica varieties were found highest in heavy metals contents than FCV tobacco except Pb contents. Overall results showed that heavy metals in tobacco cultivars are less than WHO recommended daily intake of heavy metals. The Tobacco cultivars and soil properties should be considered to explore this study further.

Key Words: Tobacco, Heavy Metals.

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INTRODUCTION

Tobacco is one of the most extensively used commodities as smoking, chewing and snuff in the world. It has been studied broadly because of its scientific uniqueness, its economic position in society and health concerns of tobacco use. The quality and chemical properties are affected by tobacco cultivars genetics, agricultural practices, soil type, nutrition absorption etc. (Miner and Tucker, 1990). Evaluation of leaf quality depends principally on the relative concentration of various organic and inorganic constituents (Tso, 1990).

A cigarette design contributes and supports smoke residues mass transport through the tobacco rod and filter. Machine smoked tar distribution contains full flavor, light, and ultra-light. Tobacco growing soils are determined by high levels of cadmium and lead, and that is toxic metals have been produced in tobacco lamina and in the smoke particulate. According to biological proves frequent inhalation of numerous toxic ingredients liberated during smoke contain genotoxic, mutagenic and carcinogenic properties and also associated with adverse pregnancy outcomes (Levent *et al.*, 2013).

Chromium (Cr) permissible limit in food and herbal supplements is 10mg or less in a day.Even when plants growth is reduced by toxicity it contains 1 or 2ug/gdry matter (Levent *et al.*, 2013).Cr toxic effects includes skin rash, nose irritations, bleeds, upset stomach, kidney and liver damage, nasal itch and lungs cancer. Chromium deficiency can cause disturbance in glucose lipids and protein metabolism (Khan *et al.*,2008).

Nickel (Ni) may be effective because it works as enzyme activator or inhibitor but its higher levels can cause toxicity. Ni toxicity in humans shows allergic reactions. The most common allergic condition is dermatitis known as nickel itch, which usually occurs in moist skin. Ni has been observed suspected carcinogen and shows harmful effects on lungs and nasal cavities. Its deficiency causes liver disorders. EPA recommended value for Ni daily intake should be less than 1mg to avoid toxicity (Khan *et al.*, 2008).

Lead (Pb) is harmful trace element having no beneficial effects in human body or plants.In humans even in low doses they stimulate various toxic effects. In herbal medicines its prescribed limit value is 10ppm while dietary intake limit is 3mg/week (Khan *et al.*, 2008). Lead exposure can cause Deficit hyperactive disorder (ADHD) that includes inattentiveness and impulsiveness (Onojah *et al.*, 2015). High exposure can affect nervous system which results various threats including severe headache,coma, delirium (incoherence and illusion) and death (Hussain and Khan, 2010).

Cadmium (Cd) accumulation in the body can generate diseases such as softening of the bones and kidney failure. Cd is well known for its relationship with itai(Pollution disease of Japan) disease. The weekly intake body limit of cadmium (Cd) according to FAQ/WHO/JECFA is 2.5mg/kg. All cigarettes brands have Cd concentration below FAQ/WHO/JECFA standard weekly intake. Cadmium (Cd) can cause serious health effect such as brain damage (Onojah *et al.*, 2015).

The present study geared around these objectives to investigate the heavy metals contents in some tobacco cultivars grown in District Mardan. Four tobacco cultivars: two FCV (Speight-G-28 and K-399) and two rustica (Rustica Swabi and Rustica-14) were selected and analyzed for heavy metals in Tobacco Research Station Khan-Garhi Mardan.

MATERIAL AND METHODS

A laboratory experiment was conducted in Tobacco Research Station Khan Garhi Mardan to Study the heavy metals contents in tobacco leaves. K-399, Speight-G-28, Rusticca Swabi and Rustica-14 were selected for analysis.

Sampling: Tobacco leaves samples were provided by Tobacco research station Khan Garhi Mardan. Three Replicates were made from each variety and labeled properly.

Samples Preparation and Grinding: Collected samples were cut into 2-4 inches size with stainless steel knife and converted into powder with the help of laboratory grinder.

Ashing: 2gm Powdered samples were weighted by electric balance. Dried and clean crucibles were weighted. Weighted samples were then placed in crucibles. The samples in the crucible were charred with the help of blowpipe. After charring the crucible were placed in the muffle furnace at 600^0C for complete ignition. Completely ignited crucibles after t w o hours were transferred to desiccators.

Digest Preparation: After cooling, the ash was transferred to 50ml volumetric flasks, 40ml distilled water and 10% HCL were added with it and mixed the solution well then placed on water bath for 20 minutes. After boiling the solutions were filtered through filter paper. The filtrates were diluted to 100ml up to mark in volumetric flasks.

Analysis: The filtrates were then run on Atomic Absorption Spectrophotometer (AAS) for elemental analysis of heavy metals. Heavy metal contents were analyzed by using the following formula:

Statistical Analysis: All the above parameters were subjected to analysis of variance (ANOVA) technique using (Statistix® 8.1) software. Significant means were compared by using LSD test at $\alpha \leq 0.05$.

RESULTS AND DISCUSSION

The observed data of heavy metals of all varieties were analyzed statistically and results are presented in the given below figures.

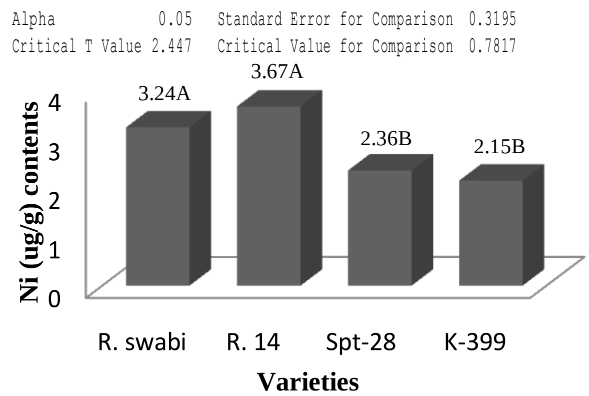

Figure-1: Nickel (ug/g) contents of Rustica and Flue Cured Virginia tobacco cultivars

The results showed that Nickel contents ranges from 2.15ug/g to 3.67ug/gm in tobacco cultivars. From figure-1, Nickel (ug/g) contents of different tobacco cultivars showed statistically significant variation ($P \leq 0.05$). Highest amount (3.67ug/g) of Nickel content was observed in Rusticca-14 while lowest amount (2.15ug/g) was noted in K-399 variety. Means of cultivars were separated using LSD test. Different characters in figure-1 showed that these means of these cultivars are different from each other while similar characters indicate similar means of cultivars. Ni contents (ug/g) were found less than the EPA critical value. The present data is in line with Khan*et al.*, (2008) who reported Ni contents in tobacco leaves below the critical level given by Environmental Protection Agency(EPA)

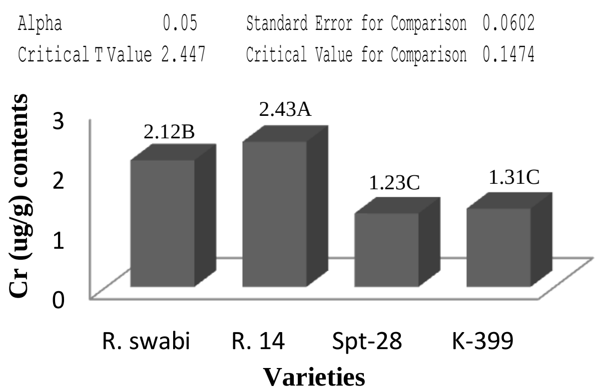

Figure-2: Chromium (ug/g) contents of Rustica and Flue Cured Virginia tobacco cultivars

Chromium contents ranged from 1.31ug/g to 2.43ug/g in tobacco samples. Figure-2 revealed that Chromium (ug/g) contents of tobacco cultivars statistically significant (P≤0.05). Highest amount of Chromium (2.43ug/g) was found in rusticca-14 while lowest amount (1.23ug/g) was observed in Speight-G-28 variety. Means of cultivars were separated by using LSD test. Similar characters showed that means are similar to each other however different characters showed that means are different from each other. The present data is supported by Levent *et al.*, (2013) who found fewer amount in tobacco than toxic level. Chromium permissible limit in food and herbal supplements is 10mg or less in a day. Even when plants growth is reduced by toxicity it contains 1 or 2ug/g dry matter. Khan *et al.*, (2008).

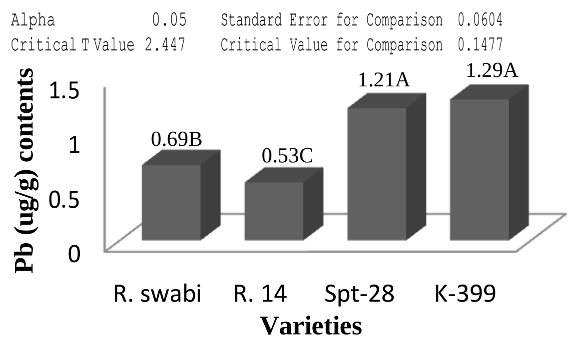

Figure-3: Lead (ug/g) contents of Rustica and Flue Cured Virginia tobacco cultivars

Looking at figure-3, the lead contents in tobacco cultivars ranges from 0.53ug/g to 1.29ug/g. Tobacco cultivars were found statistically different (P≤0.05). The highest amount of lead (1.29ug/g) was noted in K-399 variety while lowest amount (0.53ug/g) was observed in Rustica-14 variety. Means of cultivars were separated using LSD test. Same characters showed similar means of cultivars while different characters showed means are different from each other. Lead contents were found high in Flue Cure Virginia tobacco compared to rustica cultivars. Lead (Pb) concentration was observed low from daily intake limit prescribed by WHO. Khan *et al.*, (2008) reported that Lead is harmful trace element having no beneficial effects in human body or plants. In herbal medicines its prescribed limit value is 10ppm while dietary intake limit for Pb is 3mg/week.

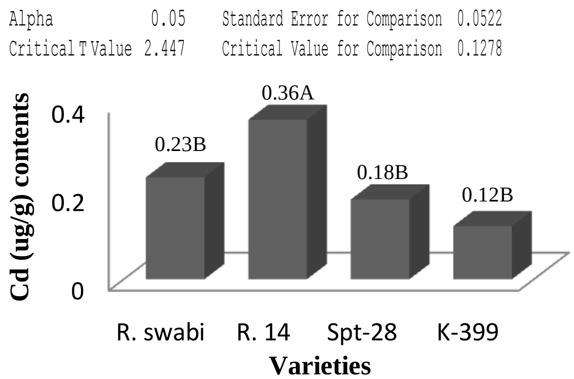

Figure-4: Cadmium (ug/g) contents of Rustica and Flue Cured Virginia tobacco cultivars

Cadmium concentration ranges from 0.12ug/g in K-399 variety to 0.36ug/g in Rusticca-14. Figure-4 showed significant variation among tobacco cultivars ($P \leq 0.05$). Highest amount (0.36ug/g) was observed in rustica-14 while lowest (0.12ug/g) in FCV K-399 variety. Flue Cured Virginia tobacco cultivars were found low in Cadmium contents compared to rusticca cultivars. Means of cultivars were separated using LSD test. Cultivars having different means were separated by distinct characters. Onojah *et al.,* (2015) support the present study and reported the concentration of cadmium (Cd) in the tobacco leaves is below FAQ/WHO/JECFA weekly intake body limit of 2.5mg/kg.

CONCLUSION

The following conclusions were drawn from the present research work:

Heavy metals contents (ug/g) in selected tobacco cultivars were found low than the critical recommended amounts of EPA and WHO. The heavy metals were found high in rustica tobacco samples compared to Flue cured Virginia tobacco samples. Lead contents were found high in Flue Cured Virginia compared to rustica tobacco.

ACKNOWLEDGMENT

I am very thankful to Tobacco Research Station Khan-Garhi Mardan Chemistry section staff members Mr. Kashan Daniel, Said-ul-Ibrar, Zahid Ullah, Naseer Gul and Asmat Ali, who helped me to complete this research.

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EFFECT AND COMPARISON OF MANUAL AND CHEMICAL CONTROL OF WEEDS ON PRODUCTION OF TOBACCO

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ABSTRACT

Comparison of hand hoeing and chemical weedicide control on production of Tobacco (FCV) was carried out at Tobacco research sub-station Mansehra in the year 2017-18. The experiment was laid-out in randomized complete block design (RCBD) planned with four treatments and three replications each. Hand hoeing was done by laborers. There were 3 manual weeding applications during the growing season at 15 DAT, 45 DAT and 75 DAT (days after transplanting). Pre-emergence herbicide was sprayed before the transplantation of tobacco into the field. And the TOPIK 15 WP herbicide for narrow weed leaves and BUCTRIL-SUPER for Broad leaved weeds were applied after transplanting at 15 DAT, 45 DAT and at 75 DAT. Data on weeds and tobacco yield were documented following the standard procedures. Manual hoeing, chemical weedicide application and their various relations portrayed a significant influence on weed and crop growth. In treatment where STOMP 330 EC was practiced, reduced the weed biomass to 124.67 gm^{-2} and weed density to 35.67 m^2 as compared to the weedy check (weeds allowed to grow whole cropping season) plot where weed biomass was 825.67 gm^{-2} and weed density was 191.07 m^2, respectively. Growth and yield were constrained in weedy check plots where weeds were allowed to grow freely in whole growing season and were recorded the highest at STOMP 330EC followed by the treatment manual hoeing was treated. Treatment with pre-emergence herbicide STOMP 330EC significantly enhanced the leaf area, plant height, cured yield and was closely followed by manual weeding treatment for these characteristics. Minimum yield was recorded in weedy check plots to 1691.7 $kgha^{-1}$ and followed by treatments where TOPIK 15WP + BUCTRIL SUPER to 1797.3 $kgha^{-1}$ respectively as against highest in STOMP 330EC to 2407.6 $kgha^{-1}$.

Keywords: FCV Tobacco, Manual weeding, chemical weedicide, stomp 330EC, Topik 15WP, Buctril Super

INTRODUCTION

Pakistan’s agriculture sector plays a central role in the economy as it contributes 18.9 percent to GDP and absorbs 42.3 percent of labor force. It is also an important source of foreign exchange earnings and stimulates growth in other sectors (Anonymous, 2018). Agriculture sector recorded a remarkable growth of 3.81 percent and exceeded its targeted growth of 3.5 percent and also last year’s growth 2.07 percent in fiscal year 2018 (Anonymous, 2018). Tobacco is an important cash crop of Pakistan. Tobacco industry employs over one million people. (Anonymous, 2002). It is widely grown in

KPK and almost 95 % of tobacco crop mainly Flue Cured Virginia is cultivated and produced for cigarettes, snuff, bidi, hukka tobacco and other tobacco products etc., in Khyber-PakhtunKhawa province of Pakistan.

FCV tobacco is mainly cultivated in Charsadda, Mardan, Sawabi, Nowshehra, Swat, and Mansehra districts of KPK. In Punjab it is mainly grown for hukka and cigarettes. Tobacco is grown in Sahiwal, Okara, Gujrat, Vehari and Rajanpur districts of Punjab province.

Tobacco crop requires heavy loam soils and with a pH range of 6.5 to 7.2. Water requirements to grow a healthy and productive crop is almost 700-800 mm for whole growing season.

Tobacco is grown at 47000 hectares while having production of 100,000 tonnes in FY 2018 (Anonymous 2018).

Pakistan, tobacco was grown on an area of 53 thousand ha in 2015-16 and production was 116 thousand tonnes. But, its production decreased to 113 thousand tons in 2016-2017 with area of cultivation at 51 thousand Hectares (Anonymous, 2017)

Yield increase is due to adoption of a number of improved cultural practices, i.e. the use of compound fertilizer, optimum plant population, better management of weeds, use of standard pesticides, topping, de-suckering and use of wet and dry bulb thermometer during curing. The tempo however, needs to be sustained rather further accelerated, as there exists a gap between the actual and potential yield of the tobacco at the farmer's fields (Yousafzai, H.K., *et al.*2006). Tobacco crop is highly fascinating by any yardstick. Not only the dose it involves scientific treatment, but it also requires special attention by the producers during the production, curing and marketing stages. Our farmers are getting poor yields of tobacco as compared to the advanced countries of the world. There are several reasons for the lower yield of tobacco among which weed infestation is the most important one. Weeds compete with crop plants for nutrients, soil moisture, space and sunlight and hence reduce yield. Most of the weeds are more competitive than the crop plants. Reduction in tobacco yield has a direct correlation with weed competition (Yousafzai, H.K., *et al.*2006). Generally, an increase in one kilogram of weed growth corresponds to a reduction in one kilogram of crop growth (Rao, 2000). Hence to control weeds is an important tool to grow a healthy and productive crop of FCV tobacco. Because weeds compete for food, nutrients, water, space and sunlight with the plants of tobacco in the field. Therefore, it is necessary to identify and to eliminate the weeds before it starts the competition of resources with the tobacco plants. In Pakistan weed removal is a very common practice to remove the weeds from the FCV tobacco fields but it is mainly done by manual approach by uprooting or manually removing the weeds. Application of chemical weedicides in FCV tobacco is not so common in Pakistan. Several researchers have emphasized the importance of chemical weed control in tobacco. (Tan *et al.* 1999) reported that herbicides were effective against weeds and even promoted the growth of tobacco (Dhanapal *et al.*, 1998) reported that the use of herbicides increased the tobacco yield by 80 to 100% when compared to control treatment. Use of herbicides effectively controlled the weeds and increased the yield (Tremola and Carotenuto, 1996). Good weed control uses crop rotation, early root destruction, cultivation, and the appropriate use of herbicides. Using an herbicide will reduce dependence on the first cultivation for early-season weed control. Herbicide use should be based upon the specific weeds present in each field, the weed-control program that integrates best with overall farm management practices (Charles S. Johnson, 2008).

Weed competition with crops for light, nutrients and water is one of the ways of weeds for interfering with normal growth of crops.

Since, in conditions of Mansehra area there is no systematic research done on the comparison of manual and chemical control on the production of FCV tobacco so a trial was conducted at Tobacco Research sub-station Mansehra with following objectives:

1. To evaluate the comparison of FCV tobacco production keeping in view the effect of conventional weeding (Hand hoeing) and chemical weed control (weedicides).
2. To check the results and efficacy of pre-emergence and post emergence chemical herbicides on weeds.

Materials and Methods

A field experiment having title of "effect and comparison of manual and chemical control on production of Tobacco" was laid out at Tobacco Research Sub-Station, Pakistan Tobacco Board, Mansehra during growing season 2017-2018. The experiment was carried out at well prepared soil having properties of sandy loam, well-drained soil with pH of around neutral, having slightly acidic in nature. The soil was prepared by 3 ploughs followed by planking, 2 disc ploughs and with one Sub-Soiler plough to break the hard pan under the soil surface. Ridges were made by manual Ridger.

1. Seed-Bed Management:

Dimension of the seed-bed was 10-meter-long, 01-meter-wide and with 15 cm elevation of seedbeds. Directions of the seedbeds were east to west to get the optimum sunlight. The seedbeds were prepared according to the standard procedure of raising the nursery of FCV tobacco. The seed rate was applied at 2-3 grams per Bed. After all the agronomic practices the seed beds were applied with proper moisture and covered by polythene plastic sheet covers to save them from the frost-bite injuries. The polythene sheet also helps to maintain the required temperature to help the seeds for germination properly and to germinate into healthy seedlings. The plastic sheets were removed during the day timings and applied again in the evening to maintain the optimum temperature and moisture to support better germination and reduction of the fungal diseases on the FCV tobacco seedlings. Precautionary sprays were also applied to stop the soil-borne fungal diseases and insects to attack on small seedlings. Seedlings having height of 10 to 12 cm were transplanted into the experimental field.

2. Experiment Layout

The experiment was conducted in RCBD design with three replications. The treatments were Control, Manual Hoeing (3 times in whole growing season), Pre-Emergence Herbicide (STOMP 330 EC), Post Emergence Herbicide (Topik 15WP + Buctril Super) The variety under trial was Speight G-28. Hand hoeing was by laborers. There were 3 hand hoeing practices throughout the growing season at 15 DAT, 45 DAT and 75 DAT (days after transplanting) through iron made hand toll (Khurpa). Pre- emergence herbicide applied before the transplantation of tobacco into the field, and Topik 15 WP herbicide for narrow weed leaves and Buctril-Super for Broad leaved weeds, applied after transplanting at 15 DAT, 45 DAT and at 75 DAT. NitroPhos, single super phosphate and SOP fertilizers for Nitrogen, Phosphorus & Potash were applied as basal dose. Fertilizer applied within a week after transplantation. All approved cultural practices and plant protection measures were adopted. The number of rows per treatment was 3 and in one row there were 10 plants. All herbicides were sprayed through hand knap sack sprayed using T-Jet nozzles. While spraying the herbicide chemicals all necessary safety measures were followed to avoid any injury or any health hazard issue due to herbicide chemical injury. The weedy check treatment was left to grow all the weeds throughout the growing season to compare it with the other weed control techniques. All other agronomic and insect pest control techniques were kept according to the standard procedure during the whole experimental growing season.

3. Parameters

During the tenure of experimental trial, the parameters studied were weed density m^{-2} (data recorded after one month of spraying of herbicide), weed biomass (m^{-2}), Plant height (cm), Number of leaves per plant, Leaf Area (cm^2), Yield per hectare (Kg), Nicotine percentage (%) and Reducing Sugar percentage (%). During recording of these parameters standard procedure was undertaken. The data recorded was subjected to the statistical analytical data technique ANOVA using computer software program Statistix (8.1 version) and the significant means were separated by Fischer's LSD test (Steel and torrie, 1980).

Results and Discussion

I. Weed Density (m^{-2}): Data on weed density m^{-2} recorded showed the different pre and post-emergence herbicide treatments had significant effects on weed density (m^{-2}). The recorded data on density of weeds per m^2 ranged from highest value of Weedy check treatment (191.07) followed by treatment applied by post emergence herbicide (161.67 m^{-2}) and the lowest weed density m^{-2} was observed in treatment where Pre-emergence herbicide was applied (35.67 m^{-2}). (Wang *et al.* 1997) reported that herbicides controlled more than 85% weeds in tobacco. Our findings are also in conformity with those reported by (Zilkey and Capell, 1987), who stated that herbicides gave excellent control of grassy and broad leave weeds.

II. Weed Biomass (gm^{-2}): Data on weed biomass recorded depicted significant results after the application of treatments of pre and post emergence herbicides. The recorded data on weed biomass g/m^2 ranged from highest value of 825.67 (gm^{-2}) to lowest value of 124.67 (gm^{-2}). The highest value observed in treatment weedy check and the lowest value observed in the treatment of pre-emergence (STOMP 330EC) was applied. These findings are in confirmatory with those of (Raghavaiah and Subbarao, 1986) who tested a mixture of 4 kg diphenamid+0.125 kg fluchloralin ha^{-1}, applied pre-planting compared with 3 hand weeding operations. Lower weed biomass was recorded in 3 hand weeded plots than diphenamid, trifluralin, nitralin, fluchloralin or alachlor.

III. Plant Height (cm): Data on plant height (cm) depicted highly significant results after the application of the treatments. The recorded data on plant height (cm) ranged from (109.23 to 90.47). The highest value was observed in treatment of Pre-emergence herbicide (STOMP 330EC) and the lowest in the treatment of weedy check where weeds were allowed to grow freely throughout the growing season. Our results are in line with the work of (Tan *et al.* 1999) who concluded that in weedy check plots, presence of weeds restricted the growth of tobacco plants, which resulted in stunted tobacco plants growth.

IV. Leaf Area (cm^2): Data on leaf area (cm^2) depicted highly significant results after the application of the treatments. The recorded data on leaf area (cm^2) ranged from (816.50 cm^2 to 560.87 cm^2). The highest value was observed in treatment of Pre-emergence herbicide (STOMP 330EC) and the lowest in the treatment of weedy check where weeds were allowed to grow freely throughout the growing season. These results agreed with (Tan *et al.* 1999) who stated that S-metalocholar, pendimethalin and acetochlor gave satisfactory weed control and were safe to use on tobacco, even promoting the crops growth. As herbicides controlled the weeds, the available resources needed for plant growth were utilized by the crop plants, which ultimately increased the leaf area. As leaf size is the final economic yield of tobacco, chemical/physical weed management in tobacco is recommended for the farmers to get higher yields.

V. Number of leaves per plant: Data on number of leaves per plant depicted highly significant results after the application of the treatments. The recorded data on no. of leaves per plant ranged from (23.8 to 18.6). The highest value was observed in treatment of Pre-emergence herbicide (STOMP 330EC) and the lowest in the treatment of weedy check where weeds were allowed to grow freely throughout the growing season.

VI. Nicotine Percentage (%): Data on nicotine percentage depicted highly significant results after the application of the treatments. The recorded data on nicotine percentage ranged from (4.18 % to 2.03 %). The highest value was observed in treatment of Pre-emergence herbicide (STOMP 330EC) and the lowest in the treatment of weedy check where weeds were allowed to grow freely throughout the growing season. (Lolas 1994) also stated that all herbicidal treatments increased nicotine % $plant^{-1}$ from control values.

VII. Reducing Sugar (%): Data on reducing sugar percentage depicted highly significant results after the application of the treatments. The recorded data on reducing percentage ranged from (12.62 % to 8.197 %). The highest value was observed in treatment of Pre-emergence herbicide (STOMP 330EC) and the lowest in the treatment of weedy check and the treatment where post emergence herbicides were applied.

VIII. Yield (kg/Ha): Data on yield (kg/Ha) showed highly significant results after the application of the treatments. The recorded data on yield (kg/Ha) ranged from (2407.7 kg/Ha to 1691.7 kg/Ha). The highest value was observed in treatment of Pre-emergence herbicide (STOMP 330EC) followed by treatment of Manual hoeing showing value of 1822.3 kg/ha and the lowest in the treatment of weedy check where weeds were allowed to grow freely throughout the growing season. Our findings are in agreement with the work of (Kalinova and Kostova, 1996). They stated that the use of herbicides increased the tobacco yield. (Dimeska and Stojkov, 1987) stated that in transplanted tobacco, Stomp (pendimethalin) was most effective, increased tobacco yield by 15-74%, and raised gross income by 35-95%.

Table 01: Mean performance of Weed density m^{-2}(WD), Weed Biomass m^{-2}(WBM), Plant Height cm (PH), Leaves $plant^{-1}$(LPP), Leaf Area cm^2 (LA), Nicotine % (N%), Reducing Sugar %(RS%), Yield per Hectare (YLDH)

Treatments	WD	WBM	PH	LPP	LA	N%	RS%	YLDH
Weedy check	**191.07 A**	**825.6 A**	90.47D	18.633 D	560.87 D	2.030 D	8.197 C	1691.7 D
Manual Hoeing	109.33 C	147.8 C	103.2B	22.233 B	702.80 B	3.213 B	10.057 B	1822.3 B
Pre-emergence	35.67 D	124.6 D	**109.2A**	**23.800 A**	**816.50 A**	**4.183 A**	**12.62 A**	**2407.7 A**
Post-Emergence	161.67 B	418.6 B	100.9C	20.600 C	677.87 C	2.570 C	8.973 C	1797.3 C

Fig.01: Weed Density m^{-2}

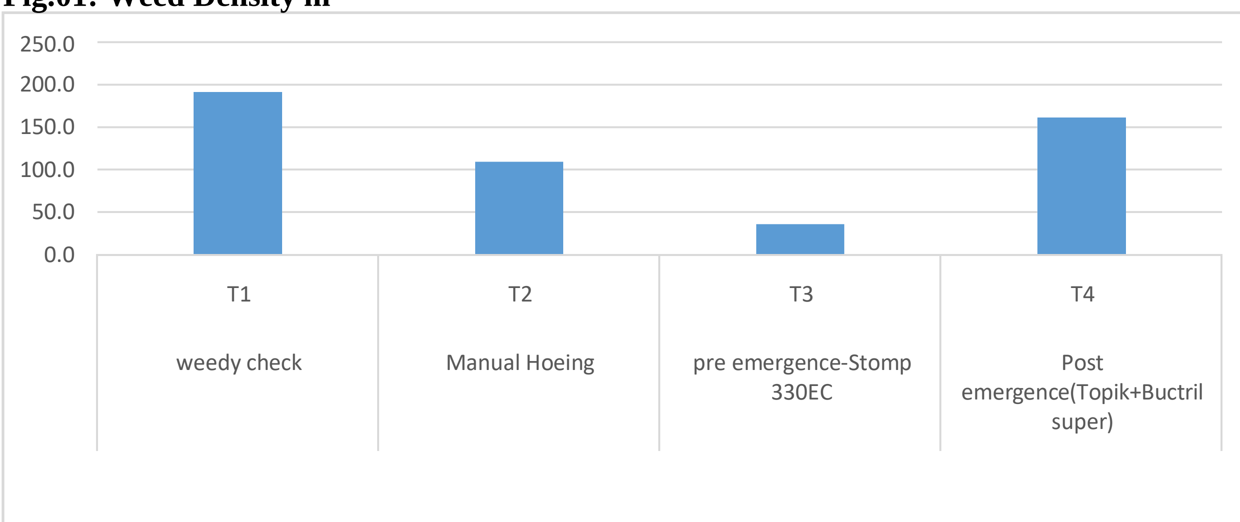
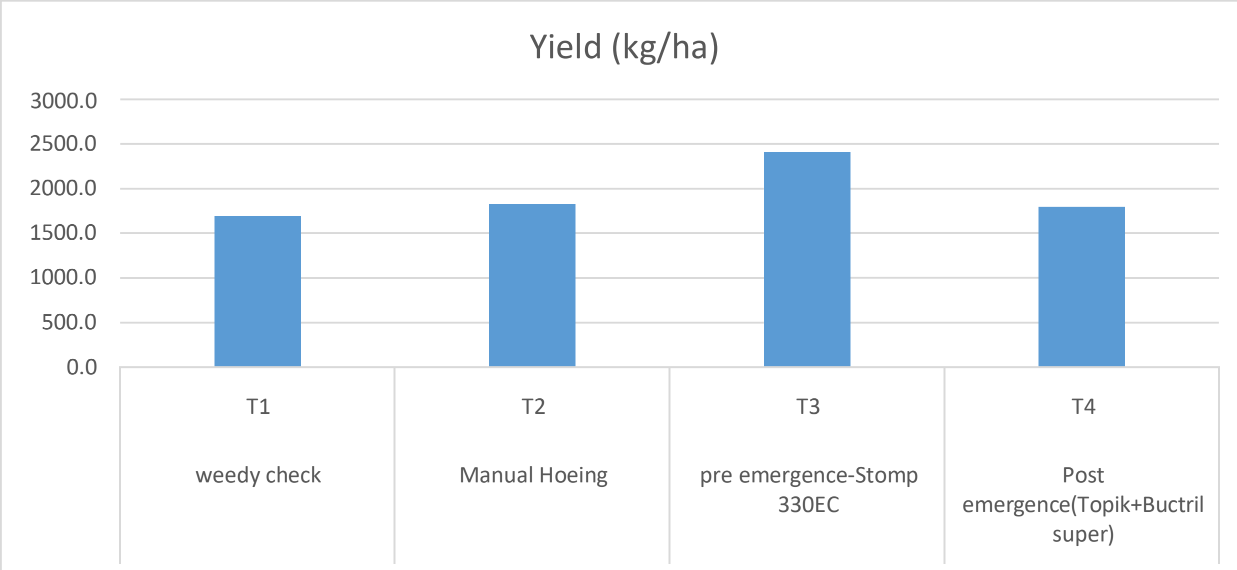


Fig. 02: Yield (kg/ha)



Conclusion and Recommendations

Weed infestation cause considerable damage and loss in production of FCV tobacco. Manual weeding method is effective but laborious and time consuming. Chemical weedicides carried greater effect on controlling of weeds. Pre-emergence weedicide like STOMP 330EC found to be most significant in controlling weeds in FCV tobacco. Post-emergence herbicides (TOPIK + BUCTRIL SUPER) to control broad leaf and narrow leaf weeds were found to be not more effective than the conventional method of manual weeding. Good early manual weeding in FCV tobacco is recommended.

Application of herbicidal treatments reduces the weed density and weed biomass thus the nutrients and other resources can be used by tobacco plants more efficiently. During the wet periods of the field, weeds becomes more noxious to control and hence a laborious work to eradicate them. Thus, herbicidal application offers more effective and economical solution to control narrow and broad leaved weeds in FCV tobacco.

As, STOMP 330 EC was used against weeds and was not applied on tobacco plants, so there were no any visible or chemical residual effects recorded on FCV Tobacco plants. So STOMP 330 EC is highly recommended for controlling of weeds by farmers.

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COMPARATIVE EFFECTIVENESS OF DIFFERENT INSECTICIDES IN CONTROL OT TOBACCO BUDWORM

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ABSTRACT

A research trial to check the efficiency of different chemical pesticides to control the attack of Budworm on the Dark Air Cured crop was conducted at Tobacco Research Sub-Station, Kunjah, Gujrat. Experiment comprised of five treatments which were applied while using Randomized Complete Block Design (RCBD) with 4 replications. Results revealed that Talstar performed best as compared to the other treatments while pairwise comparison showed that only Talstar was expressing statistically significant difference as compared to the all other treatments and all the treatments (pesticides) showed significant difference from the control.

Key words: Tobacco, Budworm, Insecticide, Pest, Kunjah, Gujrat.

INTRODUCTION

Tobacco belongs to the genus *Nicotiana* of *Solanaceae* family and is a tall green leafy plant, originated from America and now grown in sub-tropical and tropical areas around the world. It has become an important cash crop of communities throughout the globe due to its high and reliable income. Tobacco is being cultivated on only 0.25 % cultivable area of Pakistan and only 1.2 million people are directly or indirectly related to the farming, manufacturing, distribution and retailing of the crop or products. In spite of these small figures, tobacco sector is among one of the main contributors to the Government exchequer and contributed more than 3% to annual GDP of country in fiscal year 2015-16 (Statistical division, 2016). Insect pests are among the most important factors responsible for lower yields and poor quality of tobacco in Pakistan. Several insect species have been reported to cause serious damage to tobacco right from the start at seed bed stage to curing barns and sheds, in the form of attack on roots, destruction of leaves and buds, reduction of leaf quality and transmission of several harmful plant diseases.

The tobacco budworm (*Heliothis virescens)* is one of the most common insects of Tobacco and is found throughout the tobacco growing areas of Pakistan. It can severely damage the crop if not managed and controlled properly. It is an especially troubling pest because of its ability to develop resistance against insecticides (Bagwell *et al.*, 1998; Payne *et al.*, 1999). Its host plants include tobacco, potato, tomato, gourds, okra, cabbage, sugar beet, turnips, grams and many ornamental plants, at different times of the year and in different localities (Khan, 1976). It attacks right after the transplantation of seedlings and feeds on new emerging leaves. The larvae of the second generation eat into the seedpod and on the suckers (Hussain *et al.*, 1979). Larvae bore into buds and blossoms (the reason for the common name of the insect) and sometimes the tender terminal foliar growth, leaf petioles, and stalks. Neunzig (1969) reported that in the absence of reproductive tissue budworm larvae feed readily on foliar tissue. Quality of the cured tobacco leaves is seriously affected due to the attack of budworm and crop fetches low market price and eventually the growers face enormous financial losses (Patil and Chari, 1977). Various control measures are used to minimize crop losses caused by this pest (Kharboutli *et al.,* 1999). Insecticides play a major role in controlling the attack of Budworm and a whole range of insecticides are available in the market for its effective control. Cultivation of the crop in large areas with sole dependence on insecticides at various doses has developed resistance in the pest. Extensive use of synthetic pyrethroids on tobacco, against budworm has become resistant at several locations in the world (Dhingra *et al.,* 1988 and Armes *et al.,* 1992). Objective of this study is to develop an effective management strategy for the chemical control of tobacco budworm by evaluating and comparing of different new insecticides.

MATERIALS AND METHODS

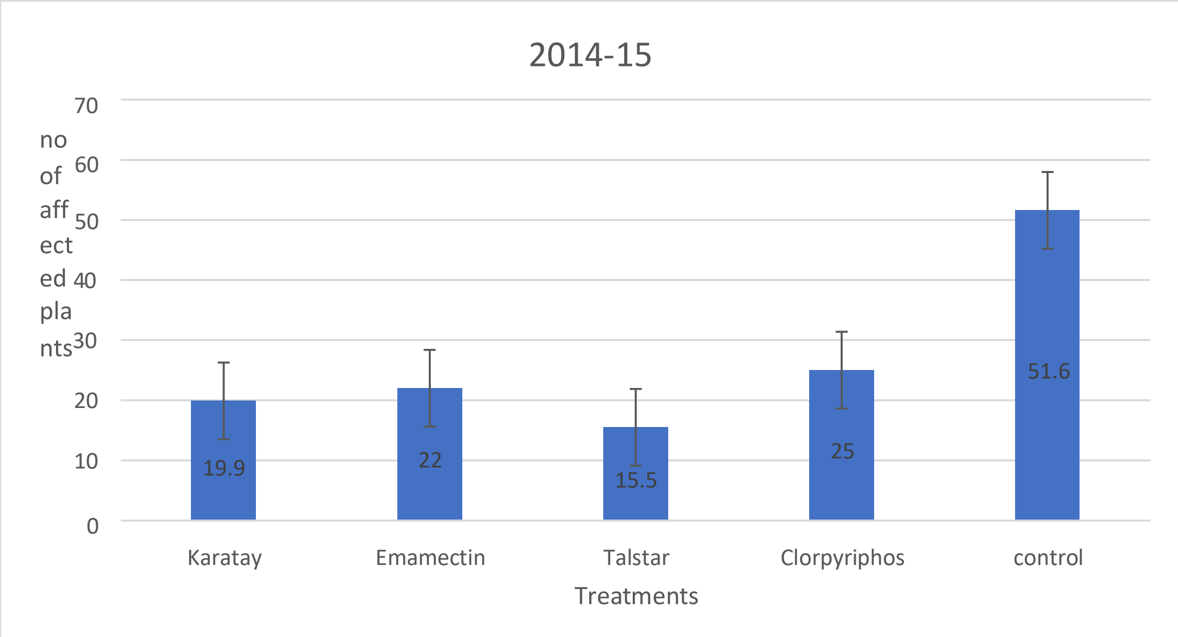
A research trial to check the efficiency of different chemical pesticides to control the attack of Budworm on the Dark Air Cured tobacco crop was conducted at Tobacco Research Sub-Station, Kunjah, Gujrat during the crop year 2014-15 and was repeated in crop year 2015-16 for standardization. The transplantation of tobacco nursery was carried out in the mid-end of February of each year. Plants were planted while maintaining plant to plant and row to row distance of 60 cm and 90 cm, respectively. Following five treatments were applied while using Randomized Complete Block Design at the prescribed rate and 4 replications/un-treated control.

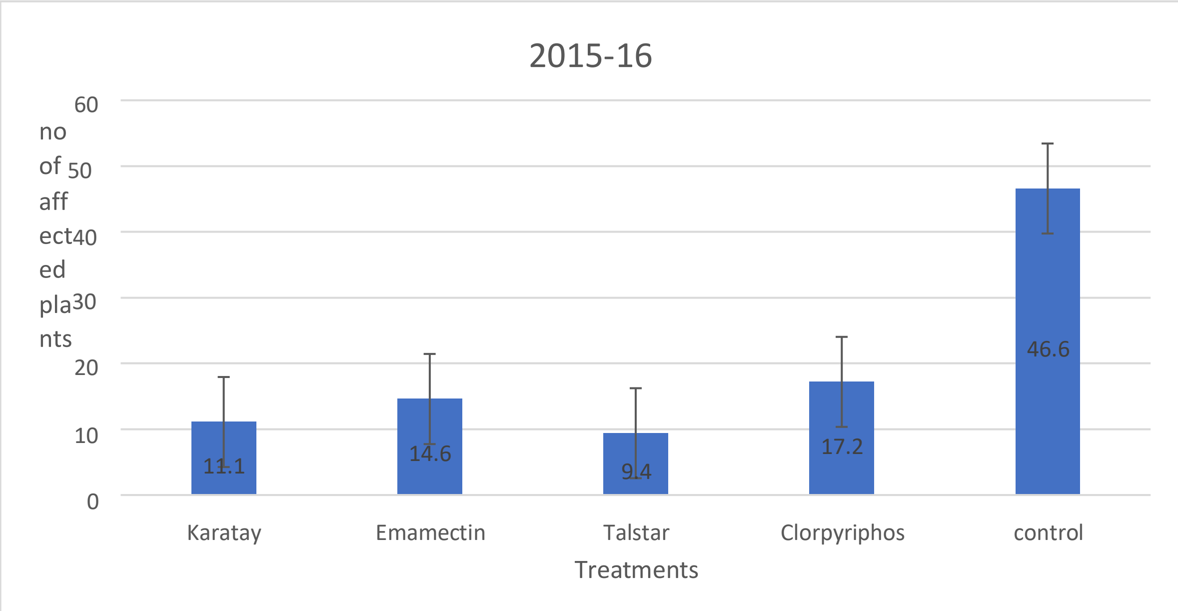
S. No.	Treatments	Active Ingredient
1	Karatay @ 200 ml/acre	Lambda cyhalothrin
2	Emamectin @ 250 ml/acre	Emamectin benzoate
3	Talstar @ 250 ml/acre	Bifenthrin
4	Chlorpyrifos @ 250 ml/acre	Chlorpyrifos
5	Control	No Application

Recommended dose of the pesticides was applied to the plants and after 5 days pest scouting was done to check the number of pests affected plants. Collected data was subjected to the statistical analysis using Computer based statistical package (Statistix® 8.1) based on Steel and Torrie (1980). Significant means were compared using LSD test at $\alpha < 0.05$.

Results and Discussion

All four insecticides significantly reduced the number of attacked plants in both years as compared to control. Results exhibit that the Talstar performed best in effectively controlling the budworm with only 15.5 % attacked plants in 2015 and 9.5 % attacked plants in 2016 followed by Karatay (19.9 and 11.1 %), Emamectin (22 and 16.6 %) and Clorpyriphos (25 % and 17.2 %) while un-treated Control had 51.6 and 46.6 % attacked plantsin 2015 and 2016, respectively. Pre-treatment observations recorded for all the plots were found significantly different.





The yield of tobacco is higher in Pakistan but its quality is inferior as compared to other tobacco producing countries (Badshah, 2005). Insect pests are one of the main reasons of this low-quality tobacco, especially the budworm (Patil and Chari, 1977). The budworm can inflict losses up to 11.35% in tobacco fields, (Aslam *et al.*, 1982; Patil, 1977). Our results showed a significant reduction in number of attacked plants. Chemical treatment proved to be statistically significant in both crop years (2015 and 2016). Minimum numbers of attacked plants were observed due to insecticide application. Talstar insecticide can be a better option for the management of Tobacco budworm as compared to the other three insecticides in Gujrat area.

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TOBACCO RESEARCH STATIONS UNDER PAKISTAN TOBACCO BOARD

S.No.	Stations	Year of establishment	Total area (acres)	Cultivable area (acres)	Area under building & roads (areas)
1.	**TRS, Mardan**	26-04-1976	22	16	6
2.	**TRSS, Mansehra**	1971	22.625	21	1.5
3.	**TMF, Buner**	2008-09	16	10	6 (uncultivable)
4.	**TRSS, Kunjah**	1977	16	13.5	2.5
5.	**TRSS, Okara**	1978	15	12.5	2.5
6.	**TMF, Pishin**	09-02-2011	20	-	-
7.	**TMF, Hazro (on lease land)**	1985	1	1	-

ACTIVITIES PERFORMED BY RESEARCH & DEVELOPMENT DURING LAST FIVE YEARS

- Approximately 60 number of Field days/Workshops are carried out at Tobacco Farmer's field to educate him about the recent trend & technologies in tobacco.
- 198 Research Trials have been carried out at Research Stations under Pakistan Tobacco Board.
- More than 220 numbers of demonstration plots are laid out at tobacco grower's field.
- Approximately 2000 numbers of leaf soil and water samples are analyzed at tobacco research station, Mardan
- More than fifty students of B.Sc. (Hons.) Agriculture and M.Sc. (Hons) Agriculture carried out their research work at Tobacco research Station, Mardan

ACHIEVEMENTS OF RESEARCH AND DEVELOPMENT

- Introduction of improved technology for raising of nursery on raised seed beds instead of flat land
- Introduction of polythene sheet for quick growth of nursery, protection from frost/cold-winds and to reduce nursery raising period
- Recommendation of 1000 sq.ft nursery area/seed bed area for transplantation of one hectare tobacco crop
- Seed rate recommendations:
  FCV and Burley 1.0 to 1.5 gm per 100 sq.ft area
  Rustica 4 gm per 100 sq.ft area
- Introduction of top ridge transplantation for better root development
- Yield improved from 900 kg to 2700 kg/hectare.
- Up gradation of Laboratories.
- 400 numbers of Tobacco Curing Barns of Tobacco growers were modified at Charsadda, Mardan, Sawabi, Buner, Mansehra and Attock to reduce Cost of Production of tobacco.

GENERAL INFORMATION

RATING CHART OF SOIL TEST DATA AND SOIL REACTION (pH).

Soil Reaction (pH)

Acidic	Neutral	Slightly Alkaline	Moderately Alkaline	Alkaline
Below 6.5	6.5-7.5	7.6-8.0	8.0-8.8	Above 8.8

S. No	Soil Texture	Fit for all crops	Suitable for Some Crops	Critical for all Crops
01.	Sandy	Below 0.4	0.4-0.8	Above 0.8
02.	Silt/Silt Loam/Loam	Below 0.7	0.7-1.4	Above 1.4
03.	Clay	Below 0.8	0.8-1.6	Above 1.6

Electrical Conductivity (dsm^{-1})

Organic Matter and NPK

S. No	Nutrients	Low	Medium	High
01.	Organic Matter %	Below 0.5%	0.5-0.75%	Above 0.75%
02.	Nitrogen %	Below 0.10%	0.10-0.15%	Above 0.15%
03.	Available P_2O_5 ppm	Below 10.00	10.00-25.00	Above 25.00
04.	Available K_2O ppm	Below 60.00	60.00-150.00	Above 150.00

Chloride %:

1. Highly suitable for FCV tobacco cultivation: Below 0.008%
2. Suitable for FCV tobacco cultivation : 0.008-0.01%
3. Unsuitable for FCV tobacco cultivation : Above 0.01%

- **RECOMMENDED SOIL COMPOSITION FOR TOBACCO CROP**

Soil Type	pH	N %	P 2O5 mg/Kg	K2O mg/Kg	Organic Matter %	Chlorides%
Sandy loam to Silt loam	5.5-6.5	0.10-0.15%	10.00-25.00	60.00-150.00	0.50-0.75	0.008-0.01

- **QUALITY TOBACCO LEAF PROPERTIES**

Type	Moisture %	Ash %	Nicotine %	Reducing Sugar %	Chloride %
F.C.V	9.8-14.0	13-17	1.5-3.50	8.0-22.0	0.5-1.0
Burley	7-12	15-23	1.80-2.74	3-6	0.8-1.5
Rustica	7-10	16-25	3.0-4.50	1-4	0.7-1.10
D.A.C	7-12	16-25	1.50-2.72	1-5	2.0-2.6

- **NPK AND STRAIGHT FERTILIZER FOR FCV TOBACCO 2019**

General NPK dose for plain areas:

Sr.No	Type of Fertilizer	Required dose (kg) per hectare	Required Dose per hectare (50 kgs/Bag)
1	N:P:K	60:60:90	10 bags
2	(i)Nitrophos (NP) (ii)Sulphate of Potash (SOP)	60:60:90	(i) 5.5 (ii)3.5
3	(i)Ammonium Sulphate (ii)Single Super Phosphate (SSP) (iii)Sulphate of Potash (SOP)	60:60:90	(i)5.5 (ii) 6.5 (iii) 3.5
4	i)Ammonium Sulphate (ii)Di Ammonium Phosphate (DAP) (iii)Sulphate of Potash (SOP)	60:60:90	i) 3.5 ii) 2.5 iii) 3.5

General dose for Hybrids (For Plains):

<u>SR.NO</u>	TYPE OF FERTILIZER	REQUIRED DOSE (KG) PER HECTARE	FERTILIZER DOSE PER HECTARE (50 KGS/BAG)
1	N:P:K + Sulphate of Potash (SOP)	60:60:120	10 bags + 1.2 bags SOP
2	(i)Nitrophos (NP) (ii)Sulphate of Potash (SOP)	60:60:120	(i) 6 (ii) 4.8
3	(i)Ammonium Sulphate (ii)Single Super Posphate (SSP) (iii)Sulphate of Potash (SOP)	60:60:120	(i)5.5 (ii)6 (iii)4.8
4	i)Ammonium Sulphate (ii)Di Ammonium Phosphate (DAP) (iii)Sulphate of Potash (SOP)	60:60:120	i) 3.5 ii) 2.6 iii) 4.8

<u>General dose for sub-mountainous areas:</u>

<u>Sr.No</u>	Type of Fertilizer	Required dose (kg) per hectare	Fertilizer Dose per hectare (50 kgs/Bag)
1	N:P:K + Sulphate of Potash (SOP)	60:60:100	10 bags + 0. 5 bags
2	(i)Nitrophos (NP) (ii)Sulphate of Potash (SOP)	60:60:120	(i)5.5 (ii) 4
3	(i)Ammonium Sulphate (ii)Single Super Posphate (SSP) (iii)Sulphate of Potash (SOP)	60:60:120	(i)5.5 (ii) 6 (iii) 4

AREA AND PRODUCTION OF TOBACCO BY DISTRICT IN KHYBER PAKHTUNKHWA

Area = Hectares

Production = Million Kg

District	2013-14		2014-15		2015-16		2016-17		2017-18	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
Charsadda	3524	11.513	4330	14.120	4362	10.870	3360	8.470	2316	6.78
Nowshera	1218	3.979	1860	4.450	1543	3.865	1156	3.010	706	2.1
Mardan Div.	3631	12.006	4123	11.160	3069	8.305	3247	8.440	4017	11.9
Swabi	16072	54.968	18727	48.250	18412	46.585	16383	40.370	13066	38.54
Mansehra	2183	7.132	2175	4.250	2271	4.480	2078	4.350	2213	4.4
Malakand	1222	3.992	1011	2.700	1020	2.780	814	2.290	624	1.90
Swat	57	0.203	42	0.100	40	0.085	38	0.094	38	0.069
Bunir	2141	6.995	2249	4.290	2505	4.920	2388	4.820	2465	5.4
Dir	-	-	-	-	-	-	-	-	9	0.016
K.P.	**30048**	**100.788**	**34517**	**89.320**	**33222**	**81.890**	**29464**	**71.84**	**25454**	**71.11**

Source: - i) **Pakistan Tobacco Board**

ii) **Directorate of Agriculture Crop Reporting Services of KP**

AREA AND PRODUCTION OF TOBACCO IN DISTRICTS OF PUNJAB

Area = Hectares

Production =Million Kg

District	2013-14		2014-15		2015-16		2016-17		2017-18	
	Area	Production	Area	Production	Area	Production	Area	Production	Area	Production
Kasur	119	0.160	65	0.090	38	0.057	24	0.036	28	0.041
Okara	565	1.123	539	1.060	471	0.892	414	0.789	396	0.759
Sahiwal	2266	2.861	2185	2.648	2226	2.771	2003	2.605	1659	2.124
Pak Patan	324	0.388	283	0.327	304	0.368	279	0.332	231	0.282

Source: **- Directorate of Agriculture Crop Reporting Services of Punjab**

INTERNATIONAL WORK

A STEP TOWARDS POSITIVE ASPECTS OF TOBACCO

Alternative Use of Tobacco as a Sustainable Crop for Seed Oil, Biofuel, and Biomass

In the years 1990 – 2002 the Italian Professor Dr. Corrado Fogher spend countless efforts in selecting offspring of *Nicotiana tabacum* for specific phenotypic traits. *Nicotiana tabacum* is the well-known tabacco species of which other varieties are used for smoking tobacco production. The phenotype is the combination of all characteristics of a plant that can be observed, a trait is certain behavior following from these characteristics. One of the traits that prof. Fogher was selecting for was low nicotine content. After many cycles of growing, testing and selecting the nicotine level of the plants dropped below the detection limit. This opened up the way for protein extraction from Solaris without nicotine ending up in the final product.

The number of flowers and amount of seeds per seedpod was the second important trait identified for optimization. Conventional tobacco has only a few branches in the top producing a few flowers with little seed. Prof. Fogher succeeded in increasing the seed output tremendously. This entitles Solaris a position in the biofuel feedstock industry. Conventional tobacco produces large leaves but little seed. Solaris has a largely improved seed production, yielding about 5000 seeds/plant. Combined with an oil content of about 38%, sunflower and rapeseed are easily outcompeted by Solaris oil productivity.

After these achievements, breeding combined with outside trials was continued to stabilize the obtained traits and improve Solaris robustness and pest resistance. This made Solaris fit for larger agronomic trials to build farming experience.

Field trials were performed in 16 countries and some multiple year trials continue to date. These trials showed that Solaris can cope with many different soil types and, as known for tobacco, can grow in a large part of the world's climates. In South Africa farming on commercial scale was rolled out in season 2015-2016. This led to the production of 18 tons of oil, converted to bio-kerosine for the 2016 test flights with Boeing and South African Airways.

Introduction of Solaris cultivation can be very valuable for the environment and local communities. Because of the high yield of the crop it requires less land than currently used oil crops. Solaris also produces multiple products at once, this reduces the risk for the farmer as there is no dependence on a single market. The fast growing plant absorbs a lot of carbon per ha and by producing feed locally also emissions related to transport are omitted. Solaris can be grown on land not suitable for food production and is a perfect replacement for tobacco farmers who currently see the demand for smoking tobacco drop. Since 2015 the Solaris project in South Africa is certified by the internationally recognized Round Table on Sustainable Biomaterials (RSB).

SOURCE
http://www.sunchem.nl/solaris/
https://hal.archives-ouvertes.fr/hal-01592374/