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Full Length Research Paper

Evaluation of introduced TANPRIDE 70 WDG insecticide in tobacco production in Tanzania

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In order to assess the performance of a new Imidacloprid 700 g/kg insecticide (TANPRIDE 70 WDG) in flue cured tobacco production and recommend appropriate dosages to farmers in tobacco production, on-farm experiments were conducted for three years at Udongo village in Sikonge district of Tabora region and on-station verification trial was done at TORITA site in Tabora region. A Randomized Complete Block Design (RCBD) with 3 replications was employed to evaluate the introduced TANPRIDE 70 WDG insecticide in tobacco production. The gross plot size was 24 m^2, the net plot was 12 m^2 and the spacing was 50 × 120 cm. There were 6 treatments as follows: Control (untreated); TANPRIDE 70 WDG, 150 gha^{-1}; TANPRIDE 70 WDG, 200 gha^{-1}; TANPRIDE 70 WDG, 250 gha^{-1}; Confidor WDG, 750 gha^{-1} (standard insecticide) and Selecron, 1500 mlha^{-1} (standard insecticide). NPK (10: 18: 24) basal fertilizer was applied followed by top dressing of CAN (27% N) at the amount of 4 bags and 1 bag (50 kg) of NPK and CAN per acre respectively. Green and cured tobacco yields showed significant difference (P<0.05) among treatments. TANPRIDE products outyielded controls (untreated and commercial chemicals). Controls had the highest insects followed by Selecron. TANPRIDE chemicals had the lowest insects' number. By adopting TANPRIDE product (200 gha^{-1}), a farmer can obtain 2380 kgha^{-1} of cured tobacco leaves equivalent to 5,743,488 Tsh/ha to pay for production costs and other incentives. TANPRIDE products were highly recommended in tobacco growing areas so as to reduce production costs and increase farmers' income.

Key words: Insecticide, insect control, Tabora, TANPRIDE, tobacco, TORITA.

INTRODUCTION

Tobacco (*Nicotiana tabacum* L.) production in Sub-Saharan Africa is dominated by small holder farmers. These farmers operate under high risk of varying environmental conditions, low yield per unit area, low capital return, low farm inputs and intensive farming which are the typical characteristics of hand to mouth farming systems (Marenya and Barrett, 2007; Matuschke et al., 2007; Sumberg, 2005). Besides that, the majority of farmers in Sub-Saharan Africa experiences economical disadvantages, high land scarcity and frequently food insecurity (Matuschke et al., 2007; Stathers et al., 2008).

In Tanzania, tobacco is one of the major cash crops benefiting the majority of farmers and other stakeholders (Ilskog et al., 2005). It is largely grown in Tabora, Songea, Shinyanga and Kigoma regions providing income and money for food purchase. However, the average yield of cured leaf tobacco is only about 750 Kgha^{-1} (Ndelemba and Shenkalwa, 2004). This yield is inadequate to cover production costs and other incentives to farmers.

Many factors have been associated with low tobacco yield in Tanzania. These factors are lack of improved varieties, low soil fertility, diseases, inappropriate crop rotation, drought, socio-economic factors and insect-pests attack (Ramadhani et al., 2002).

Tobacco belongs to the family solanaceae which is

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highly affected by many insect-pests. All categories of insect-pest ranging from soil borne, seedling, stem, leaves, flowers and seed-borne attack this plant. Insect-pests pose serious threats that result into losses of tonnes in tobacco production. They reduce leaf quality, and transmit several important tobacco diseases. The common insect-pests include cutworms, wireworms, budworms, flea beetles, slugs, grasshopper, aphids and thrips. The loss caused by insect-pest infection in tobacco production is very high. Paul (2008) noted the loss of tobacco yields that reached 25% due to aphids attack alone. This is a big loss in terms of monetary value and reduces the self-reliance for the majority of tobacco growers.

Like other crops, tobacco growers apply various methods so as to curb the insect-pest menace. The common control measures include mechanical, cultural, biological and chemical application (IPC, 2001). With the exception of chemical control, the remaining methods are laborious, slow and receive lower efficiency mode of action. However, there are some conditions necessary to make chemical application to be more effective, reliable, economical and environmental friendly.

Application of right types and dosages that target insect-pest, soil type, crop and those which are environmentally friendly gives better results in crop production (Hassan and Bakshi, 2005). In addition, chemicals which are just introduced in the area without proper testing and investigation receive low rate of adoption and subsequent abandonment (Omolehin et al., 2007).

The use of chemicals to control insect-pest has been reported to give high returns per unit area elsewhere: Martin et al. (1997) used insecticide to control pests in cashew nut in Mtwara region; Hazarika et al. (2009) used chemicals in tea managements. In tobacco, it has been used to control nematodes in many countries (Rich et al., 1989). In addition, chemical control has been used to control aphids in flue-cured and burley tobacco in many countries (Sannino et al., 2000).

In order for the chemicals to be recommended to farmers, they need to be tested on their performance, crop phyto effect and economic values. Therefore, on-farm and on-station insecticide assessment of TANPRIDE 70 WDG insecticide was carried out in Sikonge district and TORITA site in Tabora region. TANPRIDE 70 WDG is the common name of Imidacloprid 700 g/kg ($C_9H_{10}ClN_5O_2$). It is the systemic insecticide that interferes the nervous system and thus effective for control of sucking insects like aphids, thrips, whiteflies, termites and beetles in field and horticultural crops (Suchail et al., 2001). The intended product (TANPRIDE 70 WDG) is cheaper as it uses lower doses than the current one in the market. The maximum dosage for TANPRIDE 70 WDG is 250 gha^{-1} compared with Confidor WDG, 750 gha^{-1} (standard insecticide) as currently used by farmers in the field. In addition, TANPRIDE 70 WDG is relatively environmentally friendly as it has high selective toxicity to insects (Suchail et al., 2001). Thus, objectives of this study were to assess the performance of introduced TANPRIDE 70 WDG insecticide in flue cured tobacco production and recommend its appropriate dosage compared to controls and commercial chemicals currently used by farmers in tobacco production.

MATERIALS AND METHODS

On-farm experiments were conducted at Udongo village in Sikonge district for three years while on-station experiment was done at TORITA site in Tabora region for one season as verification trial.

On-farm and on-station experiments

In both on-farm and on-station trials, a Randomized Complete Block Design (RCBD) with 3 replications was employed to evaluate the introduced TANPRIDE 70 WDG insecticide supplied by Tanzania Crop Care Limited of Arusha, Tanzania. The gross plot size was 24 m^2 and the net plot was 12 m^2. Tobacco was planted at a spacing of 50 × 120 cm in 5 rows each of 5 m long. There were 6 treatments as follows:

i) Control (untreated).
ii) TANPRIDE 70 WDG, 150 gha^{-1}.
iii) TANPRIDE 70 WDG, 200 gha^{-1}.
iv) TANPRIDE 70 WDG, 250 gha^{-1}.
v) Confidor WDG, 750 gha^{-1} (standard insecticide).
vi) Selecron, 1500 $mlha^{-1}$ (standard insecticide).

The recommended fertilizer regime was employed in this trial. NPK (10: 18: 24) basal fertilizer was applied followed by top dressing of CAN (27% N) at the amount of 4 bags and 1 bag (50 kg) of NPK and CAN per acre respectively.

Agronomic data

Data were collected from three central rows to avoid border effects (Lin, 1968). The following data were measured: fresh tobacco leaf yield ($kgha^{-1}$), cured tobacco leaf yield ($kgha^{-1}$) and tobacco grade index (to reflect monetary value). Tobacco grade indices (Gi) were calculated as:

Gi = Price grade ×/ Wt grade ×+ Price grade y/ Wt grade y +... Price grade n/ Wt grade n:

$$Gi = \frac{Pricegradex}{Wtgradex} + \frac{Pricegradey}{Wtgradey} + ... \frac{Pricegraden}{Wtgraden}$$

Where: Gi = grade index, pricegradex = price of grade x, pricegradey = price of grade y, pricegraden = price of grade n, wgradex = weight of grade x, wtgradey = weight of grade y and wtgraden = weight of grade n.

Table 1. Tobacco green weight (Kg/ha) at Udongo village in Sikonge district, Tabora for 2008/2009, 2009/2010 and 2010/2011 growing seasons.

Treatments*	Year 1¥	Year 2	Year 3	Mean
Control	7600	7266	7292	7386.00
TANPRIDE 1	13371	12796	12841	13002.67
TANPRIDE 2	12694	12268	12311	12424.33
TANPRIDE 3	16872	16944	16911	16909.00
Confidor	13667	13176	13222	13355.00
Selecron	12334	11968	12010	12104.00
Mean	12756	12403	12431	
SED	1946.9	1774.8	1788.8	
CV%	18.7	17.5	17.6	

* = Treatments.
1. Control = Control (untreated).
2. TANPRIDE 1 = TANPRIDE (70 WDG, 150 gha^{-1}.
3. TANPRIDE 2 = TANPRIDE 70 WDG, 200 gha^{-1}.
4. TANPRIDE 3 = TANPRIDE 70 WDG, 250 gha^{-1}.
5. Confidor = Confidor WDG, 750 gha^{-1} (standard insecticide).
6. Selecron = Selecron, 1500$mlha^{-1}$ (standard insecticide).
¥ = Years 1, 2 and 3 denote Seasons 2008/2009, 2009/2010 and 2010/2011 respectively.

Table 2. Tobacco dry weight (cured tobacco in Kg/ha) at Udongo village in Sikonge district, Tabora for 2008/2009, 2009/2010 and 2010/2011 growing seasons.

Treatments	Year 1	Year 2	Year 3	Mean
Control	1015	982	1079	1025.30
TANPRIDE 1	2029	2008	1869	1968.70
TANPRIDE 2	2141	2034	2003	2059.30
TANPRIDE 3	2382	2427	2331	2380.00
Confidor	2158	2166	1945	2089.70
Selecron	1780	1767	1748	1765.00
Mean	1917.00	1897.00	1829.00	
SED	357.10	299.6.00	332.6.00	
CV%	22.80	19.3.00	22.3.00	

Insect damage

Insect damage assessment was done by counting the number of insects per plot per net plot (three central rows out of five).

Phyto effects

This was done by counting the number of affected plants per plot per net plot. Scoring was done by using the scale of 0-5 with the following definitions: 0 = No effect, 1 = trace to 5% effect, 2 = 6-15%, 3 = 16 - 35%, 4 = 36 - 67%, 5 = 68 - 100% effect on plant.

Data were validated and analyzed by Genstat (2006) statistical computer programme (Sannino et al. 2000).

RESULTS AND DISCUSSION

On -farm trials

Tobacco yield

Green and cured tobacco yields showed significant difference ($P<0.05$) among treatments (Tables 1 and 2). TANPRIDE products outyielded controls (untreated and commercial), chemicals which are currently used in tobacco production in the studied area. These results suggest that the use of proper chemicals yields more than the current tobacco yield of 750 $Kgha^{-1}$ (Ndelemba and Shenkalwa, 2004). The obtained extra return is vital for farmers' motivation and high possibility of adoptions.

Table 3. Effect of chemicals in control of aphids, bollworm and whiteflies at Udongo village in Sikonge district, Tabora for 2008/2009, 2009/2010 and 2010/2011 growing seasons.

Treatments	Aphids number per plot			Mean across	Boll worms number per plot			Mean across	Whiteflies number per plot			Mean across
	Year 1	Year 2	Year 3		Year 1	Year 2	Year 3		Year 1	Year 2	Year 3	
Control	21.2	123.4	56.5	67.03	1.667	2.33	5.33	3.11	1.333	1.667	4.3	2.43
TANPRIDE 1	6.7	0	0	2.23	0.1	0	0	0.03	0	0	0	0.00
TANPRIDE 2	3.2	0	0	1.07	0.133	0	0	0.04	0	0	0	0.00
TANPRIDE 3	3.6	0	0	1.20	0.067	0	0	0.02	0.033	0	0	0.01
Confidor	0.8	0	0	0.27	0.067	0	0	0.02	0	0	0	0.00
Selecron	5.2	89.3	37	43.83	0.1	0.33	1.67	0.70	0	2	0.67	0.89
Mean	6.8	35.4	15.6		0.356	0.44	1.17		0.228	0.61	0.83	
SED	8.12	11.21	18		0.1854	0.551	1.916		0.1953	1.208	0.86	
CV%	146.6	38.7	141.4		63.9	151.9	200.2		105	242.1	126	

Farmers prefer technologies that pay for capital investments and market fulfilment conditions (Mhike et al., 2012).

Effects of chemicals on tobacco insects

Table 3 depicts effects of different insecticides for controlling aphids, bollworms and whiteflies which are devastating insects in tobacco production. Generally, there were significant differences among tested chemicals. Control had the highest insects followed by Selecron. TANPRIDE chemicals had the lowest insects' number. These findings imply that chemical application reduces insect number which could be translated into high yield and good quality. Treatments with effective chemicals also showed high yield in terms of fresh and cured leaves (Tables 1 and 2). The observed results agree with those of Sannino et al. (2000) who also recorded the differential decreased number of aphids by application of different insecticides to control aphids in tobacco production in southern and northern Italy.

On-station

On-station performance of tobacco insecticides

There were no significant differences between TANPRIDE products in terms of phyto effect. This indicates that there are no noted environmental effects among them. However, commercial products showed significant difference as compared to control treatment (Table 4).

At the same time, analysis on insects infestation showed highly significant differences among treatment ($P<0.001$) with untreated and selectron insecticide recording the highest number of insects. On the other hand, TANPRIDE products had very few insects to denote its efficiency in controlling pests in tobacco industry. On green and cured tobacco yields, there were significant difference among treatments ($P<0.05$) with TANPRIDE products outyielding other treatments. The control treatment and selectron recorded the lowest yield.

Generally, Tables 1 to 4 are in acquiesce of each other. That is, for on-farm and on-station trials, fresh and cured tobacco weight is higher for chemical treated plots than controls. Also, high yields of chemical plots were reflected by low number of insects compared to untreated plots.

Economic analysis of tobacco insecticides

Economic analysis revealed that by applying TANPRIDE products, a farmer would have gained 4,471,266 - 5,743,488 Tsh/ha instead of 956,457.6 - 5,031,269 Tsh/ha by not applying insecticide or using the current commercial insecticides products (Table 5). The current 1,500,000 Tsh/ha average income from tobacco farmers led to the possible arguably high production costs in the area (Mangora, 2012). However, the portrayed yield increase showed by this study could be a good point for tobacco production revamp. The realized income could be used by farmers to reverse the environment hazards caused by forest clearing for tobacco leaf curing. In addition, the generated income could be used by farmers to cushion production costs to

Table 4. Phyto effects, aphids, bollworm, whiteflies and tobacco yield at TORITA site in Tabora for 2010/2011 growing season.

Treatment	Stand count per plot	Phyto effect visual score per plot	Aphids number per plot	Boll worms number per plot	Whiteflies number per plot	Green wt (Kg/ha)	Dry wt (Kg/ha)
Control	19	0	152.3	1.667	3.3	8077	903
TANPRIDE 1	18	0	0	0	0	16442	1973
TANPRIDE 2	20	0.33	0	0	0	17222	2067
TANPRIDE 3	19	1	0	0	0	20336	2440
Confidor	20	3	0	0.033	0	18631	2136
Selecron	19	0.67	20.5	0.333	0.33	15967	1822
Mean	20	0.83	28.8	0.339	0.61	16112	1890
SED		0.632	13.73	0.2632	0.509	2018.1	242.2
CV%		93	58.4	95.1	102	15.3	15.7

Table 5. Economic analysis of tobacco insecticides at TORITA site in Tabora for 2010/2011 growing season.

Treatments	Yield kg/ha	Grade index (US$/Kg)	Chemical cost	GFB (Tsh/ha)*	NB (Tsh/ha)*¤
Control	903	0.662	0	956457.6	956457.6
TANPRIDE 1	1973	1.417	1920	4473186	4471266
TANPRIDE 2	2067	1.51	2560	4993872	4991312
TANPRIDE 3	2440	1.472	3200	5746688	5743488
Confidor	2136	1.538	225000	5256269	5031269
Selecron	1822	1.407	81428	4101686	4020258
Mean	1890	1.334			
SED	242.2	0.0998			
CV%	15.7	9.2			

* = GFB = Gross field benefit (Dry weight × grade average price).
¤ = Net benefit = GFB- chemical cost only.

obtain high profit and return to capital investments (Shiluli et al., 2003).

CONCLUSIONS AND RECOMMENDATIONS

The three seasons experiment on tobacco insecticides showed that TANPRIDE 70 WG is better than the control and the current commercial insecticides. TANPRIDE products' treatments outyielded others and had very few insects' number. On-station verification trial showed similar trends and there were no phyto effects observed on the new product (TANPRIDE 70 WG). By adopting TANPRIDE product (200 gha^{-1}), a farmer can obtain 2380 $kgha^{-1}$ of cured tobacco leaves equivalent to 5,743,488 Tsh/ha to pay for production costs and other incentives.

By considering tobacco yield realized by application of new products, phyto effect assessment and high returns, TANPRIDE products are therefore highly recommended in tobacco growing areas. Introduction of TANPRIDE products are expected to reduce production costs and thus increase net benefits and income to to tobacco farmers. Farmers, extension department, researchers, tobacco chemical companies and policy makers could utilize these findings to fine-tune and improve production so as to realize high return and profit in tobacco production.

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