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Effect of Intra-Row Spacing on the Damage Caused By Bollworm On Cotton In Zaria, Nigeria

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ABSTRACT

Field trials were conducted at two locations in Samaru (11° 11' N, 07° 38' E and 686m above sea level) and Maigana (11° 10' N, 07° 37' E and 675m above sea level) both in Northern Guinea Savannah ecological zone of Nigeria during the 2018 wet season to determine the effects of three intra row spacing (40cm, 45cm and 50cm) on damage to cotton (SAMCOT 9) by bollworms. The experimental design was randomized complete block design. Data were recorded on the number of damaged shed squares, number of damaged shed cotton bolls and number of matured green bolls damaged by bollworms at two weeks interval beginning from 9WAS at the different phenological stages until about 90% of bolls were open, which was a period of about 16WAS before the commencement of the first picking. Significant reduction in the number of shed cotton squares, shed cotton bolls and matured green bolls damaged by bollworms were observed on the 50cm and 45cm intra row spacings than the 40cm intra row spacing.

Keywords: intra-row spacing, bollworms, cotton bolls, damage.

1.0 INTRODUCTION

Cotton an important cash crop of considerable social and economic importance in Nigeria, cultivated for its fibre and oil, mainly in the Savanna region of the Northern States in the areas extending from latitude 7° N to 13° N under rain-fed (Poswal, 1988). In cotton production, there are many factors that can reduce crop yield. One important cause is arthropod pests. Insects that cause loss to the fruit are frequently more destructive than those that damage leave, stem, and root (Mapuranga *et al.*, 2015).

1.2 Statement of problem

Cotton is subjected to yield and quality loss due to various lepidopterous pests. Among the different pests attacking cotton, bollworms account for 25-30% yield loss (Ahuja *et al.*, 2008). The African bollworm (*Helicoverpa armigera*), red bollworm (*Diparopsis castanea*), spiny bollworms (*Earias insulana* and *E. biplaga*) and pink bollworm (*Pectinophora gossypiella*) causes the greatest yield loss annually (Mapuranga *et al.*, 2015). The red and African bollworms are the key bollworm pests and can cause yield losses of up to 60 % (Matthews and Tunstall, 1994). Infestation due

1.1 Cotton production

to these insect pests also caused deterioration in lint quality and 10–40% losses in crop production (Gahukar, 2006). In Nigeria, cotton is attacked by a number of insect pests throughout the life of the crop, and caused a greater amount of damage to the crop (Raheja *et al.*, 1982). The yield loss attributable to insect pests been placed between 50-80% (Onu, 1986; 1989). These insect pests have caused serious damage to the point of causing the abandonment of cotton growing in most parts of Africa South of Sahara (Usman, 1988).

1.3 Relevant literature

The range of pests damaging cotton crops is so extensive that farmers must use more than one control tactics to reduce their damage effect. Selection of particular tactics will be influenced by the agronomic and climatic factors affecting the insect infestation and the cost of their implementation. Each tactic has to be as compatible as possible with other control measures and integrated into a pest-management programme. Many farmers have relied almost entirely on chemical control, but problems of pesticide resistance and concern about

environmental pollution have led to a reappraisal of the benefits of cultural and biological controls, and the need for integrated pest management (Matthews, 1989). Hence a suitable technology for the cotton farmers in various agroclimatic regions has to be adapted (Jothi, 2007). A number of control methods are host plant resistance, chemical control and biological control (Mapuranga *et al.*, 2015).

2.0 MATERIALS AND METHODS

The study was conducted during the 2016 wet season at two different locations situated in Institute for Agricultural Research (I.A.R) farm Samaru, (11° 11' N, 07° 38' E and 686m above sea level) and Kaduna State Agricultural Development Agency (K.A.D.A) research farm

The cotton variety used for the study was SAMCOT-9 an erect, hairy and medium staple cultivated commercial variety adapted to the North-West cotton growing zone of Nigeria under rain-fed conditions. Maturity period is between 130-150 days with a potential yield of 1500-2000Kg/ha⁻¹. It was obtained from the Cotton Research Programme of the Institute for Agricultural Research (IAR), and the seeds were treated with Dress Force 42WS (Imidacloprid 20% + Metalaxyl-M 20% + Tebuconazole 2%) 8g/Kg before sowing. Seeds were sown at 4

2.2 Methods

The fields for the experiments were ploughed, harrowed and ridged at 0.90m inter-row spacing. The treatments consisted of 3 intra row spacing (40cm, 45cm and 50cm) replicated 4 times in a randomized complete block design (RCBD)

Five plants were randomly selected from each net plot and observations were recorded on these plants on number of shed flowers/cotton squares damaged by bollworms, number of shed cotton bolls damaged by bollworms and number of matured cotton bolls damaged by bollworms. Data on number of fruiting bodies damaged by

3.1 Effect of Intra row spacing on shed cotton squares damaged by bollworms at Samaru and Maigana during 2016 wet season.

There was no significant ($P \geq 0.05$) difference on the number of damaged shed squares in both

integrated for management of bollworm pests of cotton in a way that is aimed at minimizing environmental contamination and maintaining durable suppression of pest problems. These tactics fall within the broad categories of preventative measures, cultural control,

2.1 Materials

2.1.1 Location

in Maigana (11° 10' N, 07° 37' E and 675m above sea level) both in Northern Guinea Savannah ecological zone of Nigeria. The study areas has a mean annual rainfall of 1016mm and mean maximum (32.2°C) and minimum (23.5°C) temperatures respectively.

2.1.2 Seeds and sowing:

seeds per hole at a depth of 3cm, 90cm inter-row spacing and 40cm, 45cm and 50cm intra-row spacing into the prepared ridges. Emerged seedlings were thinned to two plants per stand at 3WAS. A mixture of Paraquat and Butachlor as Pre-emergence at the rate of 1 litre/ha was applied. Supplementary hoe weeding was done throughout especially at the critical periods of weeds interference. Fertilizer was applied at the recommended rate of 60: 13: 25 Kg/ha using NPK 15:15:15 at 3 weeks after sowing (WAS) and Urea was used for top dressing at 8WA

2.2.1 Experimental design

with plot size of 4.5m x 4.5m (Gross plot of 6 rows and 4.5m long) and 3.5m x 2.7m (Net plot of 4 rows and 3.5m long). Plots within replication were separated by 1.5m alley while replication were separated by a 2.0m alley.

2.2.2 Data collection and analysis

bollworms were transformed using square root transformation. All transformed data were subjected to analysis of variance (ANOVA) using SAS software package (version 9.0). Mean differences among treatments were separated using Students Newman's Keul test (SNK) at $P=0.05$.

3.0 RESULTS AND DISCUSSION

locations except at 24hrs at Maigana, where 50cm and 45cm intra-row spacings had similar ($P \geq 0.05$) number of damaged shed squares which were significantly ($P \leq 0.05$) lower than the 40cm intra-row spacing. Significantly

($P \leq 0.05$) lower number of damaged shed squares for the two locations combined at 24hrs were also recorded on 50cm and 45cm intra-row spacings than the 40cm intra-row spacing. This observation could be as a result of the narrowness of the 40cm spacing that could allow continuous foraging activities of the bollworms, however at 50cm wider spacing, bollworms activities may be hindered on number of cotton squares that can be damage. This corroborates the finding of Butter *et al.* (1989) who evaluated the effect of intra-row spacing on the incidence of bollworms on cotton and observed that closer spacing of 75 x 15 cm recorded higher incidence of cotton bollworms on locule basis than the

wider spacing of 75 x 30 cm. Similarly, Arif *et al.* (2006) evaluated the impact of plant spacings on the population dynamic of sucking pests of cotton and reported that lower intra-row spacing (12.5cm) resulted in higher populations of both jassids (*Amrasca devastans.*) and thrips (*Thrips tabaci*) than wider intra-row spacing (32cm) that resulted in lower populations of the two insects. Mohammed (2012) reported on the impact of planting dates, space and varieties on infestation of cucumber by whiteflies and recorded lower infestation on cucumber sown at 40cm spacing, while high infestation level was observed on 20cm.

Table 3.1: Effect of Intra-row spacing on shed cotton squares damaged by bollworms 9WAS at Samaru and Maigana
Mean Shed cotton squares damaged at 24 hours and 10 days post spray application

Treatments	Samaru		Maigana		Combined	
	24hrs	10days	24hrs	10days	24hrs	10days
Intra-row spacing (cm)						
40	0.85	0.75	1.67a	1.50	1.26a	1.13
45	0.79	0.78	1.45b	1.47	1.12b	1.12
50	0.78	0.74	1.40b	1.29	1.09b	1.01
SE \pm	0.058	0.043	0.035	0.103	0.036	0.052
Significance	NS	NS	*	NS	*	NS

Means followed by same letter(s) within the same column are not different statistically at $P=0.05$ using SNK.

NS=Not significant

*= ($P < 0.05$).

3.2 Effect of Intra-row spacing on shed cotton bolls damaged by bollworms at Samaru and Maigana during 2016 wet season.

The effect of the three intra-row spacings from this study was similar ($P \geq 0.05$) on the number of damaged shed cotton bolls in both locations though 50cm spacing recorded the lowest number of damaged shed cotton bolls throughout the course of study. The similarity on number of damaged shed cotton bolls support

the finding of Jothi (2007) who reported that high crop density interferes with insecticide application leading to improper coverage. Satti (2012) reported that plant population density is very important for each crop, and when considering crop protection, such population density should be adjusted in a way suitable for plant growth, but creates less favourable microclimatic conditions for pests and diseases.

Table 3.2: Effect of Intra-row spacing on shed cotton bolls damaged by bollworms 11WAS at Samaru and Maigana
Mean Shed cotton bolls damaged at 24 hours and 10 days post spray application

Treatments	Samaru		Maigana		Combined	
	24hrs	10days	24hrs	10days	24hrs	10days
Intra-row spacing (cm)						
40	0.91	1.36	1.62	1.86	1.27	1.61
45	0.86	1.30	1.60	1.84	1.23	1.57
50	0.95	1.23	1.53	1.67	1.24	1.45

SE \pm	0.036	0.086	0.065	0.115	0.051	0.069
Significance	NS	NS	NS	NS	NS	NS

NS=Not significant at P=0.05 using SNK.

3.3 Effect of Intra-row spacing on matured cotton bolls damaged by bollworms at Samaru and Maigana during 2016 wet season.

There was no significant ($P \geq 0.05$) difference on the number of matured green bolls damaged by bollworms at the two locations. However, the number of matured green bolls damaged by bollworms from the two locations combined from the three intra-row spacing showed both 50cm and 45cm intra-row spacings to be similar ($P \geq 0.05$) but significantly ($P \leq 0.05$) more effective than the 40cm intra-row spacing. This could be as a result of the intense feeding activities of the bollworms in the narrow intra-row spacing leading to higher number of damaged matured green bolls as well as a little

reduction observed from the wider intra-row spacing which could restrict their movement in search of bolls that could be damage. This is corroborated by Mapuranga *et al.* (2015) who reported that intra-row spacing is one of the indirect cultural methods adopted for the control of bollworms which will render the target larvae more accessible to insecticides or microbial formulations applied by conventional means. Akinkunmi *et al.* (2012) also reported that narrow spacing in sunflower crop (65 cm x 75 cm) resulted in significantly higher populations of major pests and higher damage of leaves, stems and flower heads than wider spacing (100cm x 75cm) which reflected in the lowest infestation and the highest seed yield of sunflower.

Table 3.3: Effect of Intra-row spacing on matured cotton bolls damaged by bollworms in Samaru and Maigana
Mean matured cotton bolls damaged at 13 weeks and 15 weeks post spray application

Treatments	Samaru		Maigana		Combined	
	13 weeks	15 weeks	13 weeks	15 weeks	13 weeks	15 weeks
Intra-row spacing (cm)						
40	1.24	1.65	2.66	1.75	1.95	1.70a
45	1.22	1.47	2.58	1.59	1.90	1.53b
50	1.19	1.45	2.54	1.57	1.87	1.51b
SE \pm	0.079	0.087	0.042	0.106	0.056	0.061
Significance	NS	NS	NS	NS	NS	*

Means followed by same letter(s) within the same column are not different statistically at P=0.05 using SNK.

NS=Not significant

*= ($P < 0.05$).

This study was carried out to assess the effect of different intra-row spacing on the damage caused on cotton (SAMCOT-9) by bollworm. The three intra-row spacing are 40, 45 and 50cm respectively. The experimental design used was randomized complete block design arrangement. Data were recorded on the number of damaged shed squares, number of damaged shed cotton bolls and number of matured green bolls damaged by bollworms at two weeks interval beginning from 9WAS at the different phenological stages until about 90% of bolls were open, which was a period of about 16WAS before the commencement of the first picking.

4.0 CONCLUSION

Significant reduction in the number of shed cotton squares, shed cotton bolls and matured green bolls damaged by bollworms were observed on the 50cm and 45cm intra row spacing than the 40cm intra row spacing. It can be concluded from the study that the use of 50cm intra row spacing can significantly reduce bollworm damage on cotton plants. The effectiveness demonstrated by the 50cm intra row spacing in this study suggests its applicability as a potential cultural method for managing bollworms infestation on cotton which can be integrated with other methods in IPM programme in an eco-friendly manner.

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