P: ISSN NO.: 2321-290X RNI : UPBIL/2013/55327 **SHRINKHALA :** VOL-II * ISSUE-VIII*April-2015
E: ISSN NO.: 2349-980X

Evaluation of Intercroppings, Weed Control and Fertility Management Practices for Incidence of Sucking Pests and Bad Bolls Opened in Rainfed Cotton

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Abstract

A field experiment was carried out at the Agronomy Research Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS), during kharif 2007-08 and 2008-09 with an object to study the effect of intercropping, weed control and fertility management practices on incidence of sucking pests and bad bolls opened in rainfed cotton. Results indicated that the treatment of cotton + blackgram, cotton + soybean and cotton + cowpea being par recorded significantly higher incidence of aphids on cotton plant-1 at 60 DAS. Intercropping of cotton + pigeonpea, cotton + blackgram, cotton + clusterbean and cotton + marigold being par recorded significantly higher number of jassids on cotton plant-1 at 90 DAS. Treatments of cotton + soybean, cotton + pigeonpea and cotton + clusterbean being par recorded significantly higher number of tobacco leaf eating caterpillar on cotton plant-1 at 60 DAS. Treatments of intercropping of cotton + cowpea, cotton + pigeonpea and cotton + blackgram being par recorded significantly higher incidence of bad opened bolls plant-1 over cotton + soybean, cotton + clusterbean and cotton + marigold at 120 DAS. The response of various intercrops in cotton based system was found effective in reducing pest population plant-1. Normal weeding treatment recorded significantly greater aphids, jassids and tobacco leaf eating catterpillars on cotton plant-1. Every added dose of RDF increased number of incidence of bad opened bolls plant-1 at 150 DAS.

Keywords: Sucking Pests Incidence, Intercropping, Weed Control, Fertility Management, Risk Covering Factor, Rainfed etc.

Introduction

Cotton is one of the important commercial cash and fiber crop of India and it is grown on 9.2 m ha. area under diverse agro-climatic condition, out of which 70 % area is under rainfed condition. Among the major cotton growing states, Maharashtra ranks first with an area of 40.00 lakh hectares, production of 77.31 lakh Present address: Professor of Agronomy and Director, CRS, Dr. PDKV, Akola.bales and productivity of 329 kg lint ha-1. Whereas, Vidarbha occupies 15.4 lakh hectares area with production of 32.00 lakh bales and productivity of 352 kg lint ha-1 (Anonymous, 2011, d). Crop production under dry farming condition is always risky and many times partial or complete failure of crop is common. Cotton being a long duration and slow initial in growth is ideal for intercropping as risk covering factor which is promising income generation practice in rainfed cotton growing areas. From ecological perspective, rainfed cotton based cropping systems (RCBCS) provide temporal and spatial diversity in contrast to genetic and phonological uniformity of cotton monocropping. The cotton production remained stagnated over the years with low productivity. Insteed of these rainfed and dry situation, another possible reason for low productivity is losses due to pests and it is estimated to be in the range of 25-70 percent. Right from germination till the final picking, cotton crop is attacked by 135 pest species of polyphagous type. Out of them leaf hopper, aphid, jassid, whitefly and bollworm are the serious pests. More than 60 % of pesticide is being used for the control of insect pests alone in cotton, which is not only become an economical problem but also led to severe environmental pollution and drastically reduced population of useful insects (Mundas et al. 1995). Manipulation of agronomic practices such as fertilizer,

spacing, weeds, irrigation, intercrops etc. can play an important role in reducing the bollworm complex by increasing population of natural enemies (Rajput and Daware, 2002). In order to evaluate different suitable trap crops like pulses, oilseeds, flower, vegetable for increasing the production of rainfed cotton this attempt has been made to conduct the said experiment.

Materials and Methods

Two years field experiment was carried out at the Agronomy Research Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS) during kharif 2007-08 and 2008-09. The experimental site was fairely leveled and uniform in topography. The soil was medium black cotton belonging to vertisols. It was clayey in texture and moderately alkaline in nature (pH 8.3). As regard nutrient status it was medium in organic carbon (0.51 %) and available potassium (239.41 kg ha-1), low in available nitrogen (169.76 kg ha-1) and phosphorous (28.68 kg ha-1) and slightly calcarious. The total rainfall received during 2007-2008 in 23rd - 52 nd MW at Akola centre was771.0 mm in 43 rainy days, it was said to be normal year. Whereas, during 2008-2009 the total rainfall recorded was 528.2 mm in 42 rainy days and it was stated to be abnormal year. It was deficit by 30.70 % as against normal rainfall of 762.8 mm. Soon after sowing to flowering and boll development stage it had adversely affected the cotton yields.

AKH-8828 an American hirsutum variety was used for experiment. The intercrops and their varieties popular among the farmers were used in replacement series of experiment and adopted spacing of 45 × 10 cm for drilling and 45 × 30 cm for dibbling by reducing the recommended spacing of 60 × 30 cm and plant population of cotton (Anonymous, 2007). Treatment combinations were 36 with 12 Main plots (A) Intercropping (6) viz., I1- Cotton + blackgram (1:1), I2- Cotton + soybean (1:1), I3- Cotton + pigeonpea (6: 2), I4- Cotton + clusterbean (1:1),I5-Cotton + cowpea (1:1), I6- Cotton + marigold (1:1) and (B) Weed management (2) W1- No weeding and W2- Normal weeding at 25 and 50 days after sowing and three Sub plots (C) Fertilizer management (3) F1- 75 % Recommended dose of fertilizer (37.5, 18.75, 18.75 kg NPK ha-1) to base crop of cotton, F2- 100 % Recommended dose of fertilizer (50, 25 , 25 kg NPK ha-1) to base crop of cotton and F3-125 % Recommended dose of fertilizer (62.5, 31.25, 31.25 kg NPK ha-1) to base crop of cotton. The experiment was laid out in split plot design with three replications and crop was sown at the spacing of 45 × 30 cm distance. The gross plot size was 6.30 m × 3.60 m, net plot size 5.40 m × 3.00 m and recommended dose of fertilizers of cotton was 50, 25, 25 kg NPK ha-1 with no fertilizers to the intercrops. The observations were recorded and data presented for the year 2007-08 only and not for 2008-09 as there was no incidence of insect pests observed.

Results and Discussion

Incidence of Sucking Pests and Bad Opened Bolls Plant-1on Cotton

Mean incidence of pests like aphids increased from 60 DAS to 150 DAS (6.80 plant-1) and significantly affected during 90 and 120 DAS, jassid (5.97 plant-1) and number of tobacco leaf eating caterpillar (1.01 plant-1) at 90 DAS, mealy bug (5.14 plant-1) at 150 DAS, red cotton bug plant-1 (0.65) and number of bad opened bolls (1.58 plant-1) at harvest were found significantly higher (Table 1).

Effect of Intercropping

During 2007-08 only, at 60 DAS intercropping of cotton+blackgram, cotton+soybean and cotton+ cowpea being par recorded significantly higher incidence of aphids on cotton plant over other treatments. The higher infestation of aphids on cotton+blackgram/ greengram than sole cotton (Venkatesan et al., 1987) it is opined that short duration blackgram vacated the field earlier and allowed cotton to utilize the legume fixed nitrogen besides the relief of crop competition. The degree of vegetativeness of cotton intercropped with blackgram was more than sole cotton, which could be reason for attracting pests and hence more infestation (Natrajan and Seshadri, 1988). However, treatments like cotton+marigold, cotton+clusterbean and cotton+ pigeonpea were not significant. Similar findings were confirmed by Balasubramanian et al.(1998) and reported that intercropping of cotton + clusterbean recorded less number of sucking pests like aphid, jassid, thrip, whitefly and leaf hopper etc. it might be due to increased activity of predators and natural enemies like spiders and coccinellies. It is belived that clusterbean provide changes in microclimate and further allelochemicals effects to reduce sucking pests infestation (Rajendran et al., 1996). Halikeri et al. (2005) reviewed generally the intercropping is advantagegeous when component crops differ in their morphology. At 120 DAS, treatments of cotton+ blackgram, cotton+clusterbean and cotton+soybean being par showed greater incidence of aphids on cotton over other treatments. However, cotton+ pigeonpea cotton+cowpea and cotton+marigold were not significant. Number of jassids plant-1 was affected significantly at 90 DAS, at this stage intercropping of cotton+pigeonpea, cotton+blackgram, cotton+ clusterbean and cotton + marigold being par recorded significantly higher number of jassids on cotton over treatments of cotton + soybean and cotton + cowpea. Most of the intercrops in cotton based intercropping were found significantly effective in reducing the population of jassids (Jambharunkar et al., 1998). Incidence of mealy bug was not affected at any crop stage due to different treatments tried. Treatments of cotton + soybean, cotton + pigeonpea and cotton + clusterbean being par recorded significantly higher number of tobacco leaf eating caterpillar plant-1 on cotton over other treatments at 60 DAS. Other treatments of intercropping namely, cotton + blackgram, cotton + cowpea and cotton + marigold were not significant. Srinivas and Patil (2000) reported that marigold was excellent trap crop in tomato. The reason they quoted that the difference must be attributed to the height of main crop that grow taller than marigold. Hence, preference of pest diverted towards the main crop when the situation is reverse. Intercropping of cotton + cowpea, cotton + pigeonpea and cotton + blackgram being par recorded significantly higher incidence of bad opened bolls plant-1 at 120 DAS over other treatments of

intercropping. Natrajan and Seshadri (1988) reported that the red gram serves as an attractant crop for the population of H. armigera emerging from cotton after second week of October. Other treatments of intercropping namely, cotton + soybean, cotton + clusterbean and cotton + marigold were not significant. Kumarswamy and Hosmani (1978) reported that intercropping / mixed cropping of okra and marigold in cotton can reduce the bollworm and leaf minor damage. Incidence of shoot weevil in cotton was less in intercropping as lower parts of cotton were covered by intercrops.

Effect of Weed Management

Normal weeding recorded significantly greater count of aphids on cotton plant at 90, 120 and 150 DAS, number of jassids plant-1 were observed higher at 60, 90 and 120 DAS. Intercropping or the presence of weeds in the crop has been reported to decrease insect pest population as the weeds became a host for insects therefore, less population of jassids were observed in no weeding treatment (Pala Ram et al., 2002). Incidence of tobacco leaf eating caterpillar was significantly greater in the treatment of normal weeding at 120 DAS. Weed management treatments tried under study were not found significant in recording bad opened bolls plant-1 at any stages of crop growth and observations.

Effect of Fertility Management

None of the treatment of fertility management was found to be significant in recording higher production of aphids, jassids and tobacco leaf eating caterpillar on cotton plant at any of the stages of crop growth. Whereas, every added dose of RDF increased number of bad opened bolls plant-1 over its lower doses at 150 DAS. Sawai and Singh (2004) reported the increase in the level of nitrogen may increase the infestation.

Effect of Interaction

Interaction effect of intercropping×weed management × fertility management (I ×W ×F) were found significant. Treatment combination of cotton + clusterbean with normal weeding under 100 % and 125 % RDF (I4W2F2 and I4W2F3) recorded significantly higher incidence of jassids plant-1 at 150 DAS (Table 2).Treatments combination of cotton + blackgram with normal weeding under 75%, 100% and 125 % RDF (I1W2F1, I1W2F2 and I1W2F3) and cotton + pigeonpea with normal weeding under 125 % RDF (I3W2 F3) recorded significantly higher incidence of bad opened bolls plant-1 over other combinations (Table 3).

Table 1. Infestation of Insect-Pests Plant-1 on Cotton as Affected by Different Treatments During 2007-08

Treatments	**2007-08**											
I) Main plot	**Number of aphids plant^{-1}**				**Number of jassids plant^{-1}**				**Number of mealy bug plant^{-1}**			
A) Intercropping (6)	**DAS**				**DAS**				**DAS**			**At**
	60	**90**	**120**	**150**	**60**	**90**	**120**	**150**	**90**	**120**	**150**	**harvest**
I_1 Cotton + blackgram (1:1)	2.22	6.30	7.48	7.29	5.14	6.74	4.48	1.77	1.79	1.62	6.56	4.08
I_2 Cotton + soybean (1:1)	2.12	5.19	6.12	7.64	7.48	5.13	3.57	3.05	1.25	1.41	4.00	2.88
I_3 Cotton + pigeonpea (6:2)	1.14	3.79	4.35	6.62	4.91	8.23	2.92	2.38	1.89	2.18	3.03	2.02
I_4 Cotton + clusterbean (1:1)	1.60	4.10	7.13	6.98	5.79	6.06	3.30	3.20	1.81	2.57	6.73	2.72
I_5 Cotton + cowpea (1:1)	1.51	5.21	4.58	5.84	5.22	3.68	3.77	2.27	1.36	1.34	5.58	1.98
I_6 Cotton + marigold (1:1)	1.98	3.51	4.76	6.42	5.56	5.99	2.90	1.77	1.79	1.27	4.96	4.41
S. E. (m) ±	0.46	0.56	0.71	1.04	1.15	0.89	0.40	0.42	0.26	0.35	1.44	0.73
C. D. at 5%	NS	1.65	2.08	NS	NS	2.60	NS	NS	NS	NS	NS	NS
B) Weed management (2)												
W_1 No weeding	1.67	3.68	5.11	4.99	3.82	4.63	3.06	2.07	1.53	1.64	5.11	2.84
W_2 Normal weeding (2 hoeings + 2 weedings at 25 and 50 DAS)	1.85	5.69	6.36	8.61	7.55	7.31	3.92	2.74	1.77	1.82	5.17	3.18
S. E. (m) ±	0.27	0.32	0.41	0.60	0.67	0.51	0.23	0.24	0.15	0.20	0.83	0.42
C. D. at 5%	NS	0.95	1.20	1.76	1.96	1.50	0.67	NS	NS	NS	NS	NS
II) Sub plot												
C) Fertility management (3)												
F_1 75 % RDF of base crop of cotton	1.43	4.53	5.19	6.61	4.90	5.28	3.36	2.24	1.40	1.70	4.84	2.82
F_2 100 % RDF of base crop of cotton	1.68	4.63	5.86	6.85	5.92	5.98	3.37	2.34	1.66	1.71	5.04	2.98
F_3 125 % RDF of base crop of cotton	2.18	4.89	6.16	6.94	6.23	6.65	3.75	2.63	1.88	1.79	5.55	3.24
S. E. (m) ±	0.28	0.30	0.35	0.47	0.41	0.68	0.17	0.16	0.18	0.31	0.81	0.40
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
D) Interaction effects												
Intercropping x weed management (I x W)												
S. E. (m) ±	0.65	0.79	1.00	1.47	1.63	1.25	0.56	0.59	0.37	0.50	2.04	1.03
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	1.74	NS	NS	NS	NS
Intercropping x fertility management (I x F)												
S. E. (m) ±	0.68	0.73	0.85	1.14	1.00	1.66	0.42	0.39	0.45	0.75	1.97	0.97
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	1.11	NS	NS	NS	2.77
Weed management x fertility management (W x F)												
S. E. (m) ±	0.39	0.42	0.49	0.66	0.58	0.96	0.24	0.23	0.26	0.43	1.14	0.56
C. D. at 5%	NS	NS	1.39	1.87	NS	NS	NS	NS	NS	NS	NS	NS
Intercropping x Weed management x fertility management (I x WxF)												
S. E. (m) ±	0.97	1.03	1.20	1.61	1.42	2.35	0.60	0.55	0.64	1.06	2.79	1.38
C. D. at 5%	NS	NS	NS	NS	NS	NS	NS	1.57	NS	NS	NS	NS
GM	**1.76**	**4.68**	**5.74**	**6.80**	**5.68**	**5.97**	**3.49**	**2.41**	**1.65**	**1.73**	**5.14**	**3.01**

Table 1. Continue….

Treatments		**2007-08**						
I) Main plot		**Number of red cotton bug plant^{-1}**	**Number of tobacco leaf eating caterpillar plant^{-1}**			**Bad opened bolls plant^{-1}**		
A) Intercropping (6)		**at harvest**	**60 DAS**	**90 DAS**	**120 DAS**	**120 DAS**	**150 DAS**	**At harvest**
I_1	Cotton + blackgram (1:1)	0.37	0.43	1.08	0.43	0.79	0.98	1.73
I_2	Cotton + soybean (1:1)	1.36	0.72	0.94	0.47	0.57	0.92	1.82
I_3	Cotton + pigeonpea (6:2)	0.61	0.67	1.09	0.49	0.80	0.62	1.58
I_4	Cotton + clusterbean (1:1)	0.51	0.56	0.78	0.30	0.52	1.07	1.80
I_5	Cotton + cowpea (1:1)	0.54	0.43	1.26	0.41	0.85	0.89	1.37
I_6	Cotton + marigold (1:1)	0.53	0.41	0.92	0.53	0.43	0.72	1.19
S. E. (m) ±		0.36	0.07	0.15	0.06	0.07	0.18	0.29
C. D. at 5%		NS	0.19	NS	NS	0.20	NS	NS
B) Weed management (2)								
W_1	No weeding	0.44	0.51	0.94	0.38	0.64	0.85	1.57
W_2	Normal weeding (2 hoeings + 2 weedings at 25 and 50 DAS)	0.86	0.56	1.08	0.50	0.68	0.89	1.60
S. E. (m) ±		0.21	0.04	0.08	0.03	0.04	0.10	0.17
C. D. at 5%		NS	NS	NS	0.10	NS	NS	NS
II) Sub plot								
C) Fertility management (3)								
F_1	75 % RDF of base crop of cotton	0.50	0.47	0.88	0.35	0.56	0.71	1.39
F_2	100 % RDF of base crop of cotton	0.54	0.54	1.03	0.44	0.69	0.84	1.51
F_3	125 % RDF of base crop of cotton	0.92	0.59	1.12	0.53	0.73	1.05	1.85
S. E. (m) ±		0.26	0.05	0.08	0.05	0.06	0.09	0.18
C. D. at 5%		NS	NS	NS	NS	NS	0.27	NS
D) Interaction effects								
Intercropping x weed management (I x W)								
S. E. (m) ±		0.50	0.09	0.21	0.08	0.10	0.25	0.41
C. D. at 5%		NS	NS	NS	NS	0.28	NS	NS
Intercropping x fertility management (I x F)								
S. E. (m) ±		0.63	0.11	0.19	0.13	0.15	0.23	0.44
C. D. at 5%		NS	NS	NS	NS	NS	NS	NS
Weed management x fertility management (W x F)								
S. E. (m) ±		0.36	0.06	0.11	0.08	0.08	0.13	0.26
C. D. at 5%		NS	NS	NS	NS	NS	NS	NS
Intercropping x Weed management x fertility management (I x W x F)								
S. E. (m) ±		0.89	0.16	0.27	0.18	0.21	0.32	0.63
C. D. at 5%		NS	NS	NS	NS	0.59	NS	NS
GM		**0.65**	**0.54**	**1.01**	**0.44**	**0.66**	**0.87**	**1.58**

Table 2. Number of Jassids plant-1 of cotton as affected by intercropping x weed management x fertility management interactions at 150 DAS during 2007-08

Treatments	**Intercropping x weed management x fertility management**		
IxWxF	**F_1**	**F_2**	**F_3**
I_1W_1	0.80	2.00	2.50
I_1W_2	1.20	1.70	2.40
I_2W_1	3.20	3.40	5.70
I_2W_2	1.20	2.10	2.70
I_3W_1	0.60	1.50	1.80
I_3W_2	1.30	4.20	4.90
I_4W_1	0.70	0.80	1.90
I_4W_2	2.20	4.70	8.90
I_5W_1	1.50	1.60	3.90
I_5W_2	1.90	2.30	2.40
I_6W_1	1.60	1.60	1.20
I_6W_2	2.20	1.90	2.10
S. E. (m) ±		0.55	
C. D. at 5%		1.57	

Table 3. Number of bad opened bolls plant-1of cotton as affected by intercropping x weed management x fertility management interactions at 120 DAS during 2007-08

Treatments	**Intercropping x weed management x fertility management**		
IxWxF	**F_1**	**F_2**	**F_3**
I_1W_1	0.67	0.73	0.80
I_1W_2	0.73	0.90	0.90
I_2W_1	0.50	0.53	0.73
I_2W_2	0.33	0.50	0.80
I_3W_1	0.40	0.50	0.80
I_3W_2	0.50	0.80	1.80
I_4W_1	0.30	0.40	1.07
I_4W_2	0.40	0.40	0.53
I_5W_1	0.50	0.60	1.33
I_5W_2	0.53	0.73	1.40
I_6W_1	0.40	0.60	0.60
I_6W_2	0.27	0.30	0.40
S. E. (m) ±		0.21	
C. D. at 5%		0.59	

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