Research Article

Effect of Intercropping on the Incidence of Jassid (*Amrasca Biguttula Biguttula* ish.) And Whitefly (*Bemesia Tabaci* Guen.) In Okra (*Abelmoschus Esculentus* l. Moench) in Kaski, Nepal

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Abstract

An experiment was conducted to screen the superior intercrop with okra to minimize the incidences of insect jassids and whiteflies in "Didi Bahini Krishi Farm" in Arghau, Kaski, Nepal from March 4, 2018 to May 24, 2018.The experiment was done in single factorial Randomized Complete Block Design with five treatments and four replications. The population of jassids and whiteflies were recorded in three leaves and the yield parameters were recorded and analyzed. The population of jassids and whiteflies were observed the lowest in okra intercropped with coriander. The lowest number of jassids per three leaves at 30, 40, 50 and 60 days after sowing were 5.50, 6.94, 8.00 and 3.69 respectively when okra was intercropped with coriander. The lowest population of whiteflies per three leaves at 30, 40, 50 and 60 days after sowing were 7.50, 8.56, 10.25 and 7.06 respectively when okra was intercropped with coriander. The population of jassids and whiteflies were the highest when okra was intercropped with parsley and when grown alone. The average pod length was highest (17.92 cm) with the highest yield (28.20 t/ha) when okra was intercropped with coriander. Average pod length was the lowest (16.42 cm) with the lowest yield (27.58 t/ha) when okra was intercropped with carrot. The highest revenue was obtained from the intercrop coriander (Rs.1605208 per ha/season) followed by carrot (Rs.689305.6 per ha/season). The revenue obtained from fennel and parsley were Rs 401423.6 per ha/season and Rs 419444.4 per ha/season respectively. The benefit cost ratio was the highest when okra was intercropped with coriander (3.00) followed by okra intercropped with carrot (2.09) and was the lowest when grown alone (0.81).

Keywords: Okra; Intercrop; Insects; Jassid; Whitefly

Introduction

Okra (*Abelmoschus esculentus* L. Moench) is one of the most important summer vegetables. The infestation of insects like jassid (*Amrasca biguttula biguttula* Ish.), whitefly (*Bemesia tabaci* Guen,) etc are major constraints in increasing the productivity of insects. Farmers are using the chemical methods of pest control to increase the production. In order to prevent the hazards of chemical pesticides, farmers must be encouraged to adopt intercropping systems. So, to help farmers to develop the pest suppressive agro ecosystem and minimize the pesticide use different crops were incorporated as intercrops with okra.

Materials and Methods

The research was conducted during summer season 2018 in Lekhnath-27, Kaski. It was laid on Randomized Complete Block Design. The plot size was 2m x 1.8m. The variety of okra used was Arka anamika, carrot was New karuda, parsley was curly leaved parsley, fennel and coriander was local variety. Okra and other intercrops were directly sown in alternate rows. The treatment T_1 consists of okra only, T_2 consists of okra and coriander, T_3 consists of okra and carrot, T_4 consists of okra and fennel and T_5 consists of okra and parsley.

In each treatment four plants were taken as sample plants for observation of jassid and whitefly population in three leaves (one

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upper, one lower and one buttom leaves) of each plant. The fruits were harvested from 50 days after sowing to 80 days after sowing at weekly intervals and average was calculated. The yield parameters like average pod length and average number of fruits per plant was observed and analyzed. The data was analyzed using R-STAT software.

Results and Discussion

Effect of intercropping in the incidence of jassid in okra

The number of jassid per three leaves per plant of okra was significantly different in all the treatments at 30, 40, 50 and 60 days after sowing. The number of jassid per three leaves per plant of okra was significantly lower in okra intercropped with coriander than other treatments.

At 30 DAS the number of jassid per three leaves per sample plant was the lowest (5.50) when okra was intercropped with coriander. The highest number (10.81) of jassid per three leaves per sample plant was observed in control followed by okra intercropped with parsley (9.75).

At 40 DAS number of jassid per three leaves per plant of okra was significantly lower (6.94) when okra was intercropped with coriander. The highest population (12.50) of jassid was found in control followed by okra intercropped with parsley (11.63) which was at par to okra intercropped with carrot (10.63).

At 50 DAS number of jassid per three leaves per plant of okra was significantly lower (8.00) in okra intercropped with coriander. The highest number (14.94) of jassid per three leaves per plant of okra was observed in control followed by okra intercropped with parsley (13.63) which was statistically similar to okra intercropped with fennel (12.56). The number of jassid per three leaves per plant of okra when okra was intercropped with fennel (12.56) and okra intercropped with carrot (12.38) was at parity.

At 60 DAS the number of jassid per three leaves per plant of okra was significantly lower (3.69) when okra was intercropped with coriander. The number of jassid per three leaves per okra plant was at parity in all other treatments.

If we look at the trend of number of jassid per three leaves per plant of okra at 30, 40, 50 and 60 days after sowing the number of jassid per three leaves per plant of okra is in increasing trend upto 50 days after sowing and declining at 60 days after sowing supported by finding of Mote [1].

The reason behind the increase in population of jassid with plant age was mentioned by Ragumoorthi and Kumar [2] who stated in the vegetative phase, population was comparatively less in

all the bhendi lines than near maturing crop (60 day). This may be due to the thinner veins of early stage crop, which further developed into thicker vein and thereby favored a greater number of jassid on leaf. Similarly, as the age of the plant increase, increase in the size of leaf lamina, decreases the hair density and increases the population of jassid.

The lowest number of jassid per three leaves of okra plant when okra was intercropped with coriander in all the observations might be due to pest repellent nature of coriander due to presence of volatiles and increase in number of natural predators of jassid like spiders, ladybird beetles, etc.

Sujaynand., *et al.* [3] stated that twenty one volatile compounds were present in coriander, 7 in marigold, and 18 in mint and the greatest mean number of coccinellids (1.25 per plant) and largest Shannon-Wiener indices were recorded from treatment coriander as intercrop. The presence of these volatiles repels insect pests and increase in natural enemies favor lower population of jassid which is supported by Sujayanand., *et al.* [3] who stated that the volatiles from coriander and marigold likely acted to repel leafhoppers, resulting in smaller populations than the sole crop. Similarly, Wagan [4] stated that natural enemies control the pest population, also the same time agro ecosystem encourage the activities of predators. They also noticed that different predator populations appeared and suppressed the jassid populations which can be considered the best sources of pest control in the field.

Treatments	Number of jassid per three leaves per okra plant			
	30DAS	40DAS	50DAS	60DAS
Okra only	10.81^a± 0.84	12.50^a ± 0.65	14.94^a ± 0.67	9.31^a ± 0.85
Okra+ Coriander	5.50^d± 0.29	6.94^c ± 0.43	8.00^c ± 0.41	3.69^b ± 0.76
Okra+ Carrot	8.63^{bc} ± 0.38	10.63^{ab} ± 0.69	12.38^b ± 0.38	10.50^a ± 0.5
Okra+ Fennel	8.00^c ± 0.00	10.38^b ± 0.68	12.56^b ± 1.03	9.50^a ± 0.29
Okra+ Parsley	9.75^{ab} ± 0.37	11.63^{ab} ± 0.63	13.63^{ab} ± 0.24	9.94^a ± 0.78
F test	***	***	***	***
L.S. D$_{0.05}$	1.16	1.81	1.93	2.22
C.V (%)	8.80	11.29	10.17	16.79

Table 1: Population of jassid per three leaves per okra plant in different intercropping system at Lekhnath-27, Kaski, 2018.

DAS: Days After Sowing, LSD: Least Significant Difference, CV: Coefficient of Variation, Value with Same Letters in the Column is not Significantly Different at 5% by DMRT and figures after ± indicates standard error.

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Effect of intercropping in the incidence of jassid in okra

The number of white flies per three leaves per plant of okra was significantly different in all the treatments at 30, 40, 50 and 60 days after sowing. The population of whitefly was significantly lowest when okra was intercropped with coriander.

At 30 DAS, the lowest number (7.50) of white fly per three leaves per okra plant was found when okra was intercropped with coriander. The highest population (12.56) of white fly was found when okra was intercropped with parsley which was statistically similar to control (11.81) and okra intercropped with carrot (11.25).

At 40 DAS, the lowest number (8.56) of white fly per three leaves per okra plant was found when okra was intercropped with coriander. The highest population (14.63) of whitefly was observed when okra was intercropped with parsley followed by control (13.06) which was at par with okra intercropped with carrot (13.38).

At 50 DAS, the lowest number (10.25) of white fly per three leaves per okra plant was observed when okra was intercropped with coriander. The highest population (15.31) of whitefly was observed when okra was intercropped with parsley which was statistically similar to control (15.13), okra intercropped with carrot (12.81) and okra intercropped with fennel (14.25).

At 60 DAS, the lowest number (7.06) of white fly per three leaves per okra plant was observed when okra was intercropped with coriander. The highest population (12.31) of whitefly was found in control which was statistically similar to okra intercropped with carrot (12.00), okra intercropped with parsley. (11.56) and okra intercropped with fennel (11.50).

The increase in the number of white flies per three leaves per okra plant up to 50 DAS and decrease in population after 50DAS is in agreement to Mote [1] who states the population of all whitefly reached peak at 43 days and slowly started declining. At each observation the number of whiteflies per three leaves per plant of okra is found lowest in okra intercropped with coriander which can be supported by Tongi., *et al.* [5], who demonstrated that intercropping tomato with coriander reduces the incidence and severity of damage caused by whitefly who also stated that how coriander affects the insect's behavior is still unknown. He further suggested that coriander constitutive volatiles interferes host plant selection of whitefly. Mann., *et al.* [6], reported that Linalool and alfa-pinene

are major volatiles found in coriander which might be the reason for the decrease in population of insects in plot where coriander is used as intercrop.

Ngoh., *et al.* [7]; Ukeh., *et al.* (2007) [8]; Sfara., *et al.* [9] reported that Linalool and alfa-pinene have reported to repel or kill several herbivore insects including Hemipterians.

Hilje and Stansly [10], Togni., *et al.* [5] coriander plants have been successfully intercropped with tomatoes to manage whiteflies by reducing the number of incoming adults.

Treatments	Number of whitefly per three leaves per okra plant			
	30DAS	**40DAS**	**50DAS**	**60DAS**
Okra only	11.81^a ± 0.64	13.06^b ± 0.42	15.13^a ± 0.31	12.31^a ± 0.87
Okra+ Coriander	7.50^b ± 0.59	8.56^c ± 0.19	10.25^b ± 0.66	7.06^b ± 0.42
Okra+ Carrot	11.25^a ± 0.25	13.38^{ab} ± 0.24	14.81^a ± 0.28	12.00^a ± 0.207
Okra+ Fennel	11.44^a ± 0.31	12.25^b ± 0.05	14.25^a ± 0.37	11.50^a ± 0.29
Okra+ Parsley	12.56^a± 0.53	14.63^a ± 0.38	15.31^a ± 0.43	11.56^a ± 0.32
F test	***	***	***	***
L.S.D$_{0.05}$	1.51	1.36	1.38	1.93
C.V (%)	9.28	7.12	6.43	11.54

Table 2: Number of whitefly per three leaves per plant of okra in different intercropping system at Lekhnath-27, Kaski, 2018

DAS: Days after sowing, LSD: Least significant difference, CV: Coefficient of variation, Value with same letters in the column is not significantly different at 5% by DMRT and figures after ± indicates standard error.

Regression analysis of insect pests damage in yield of okra

The Figure 1 shows the Relationship between Average insect count and Yield (t/ha) which shows that the decrease in yield was due to increase in insect count and the contribution was 86.69 percent.
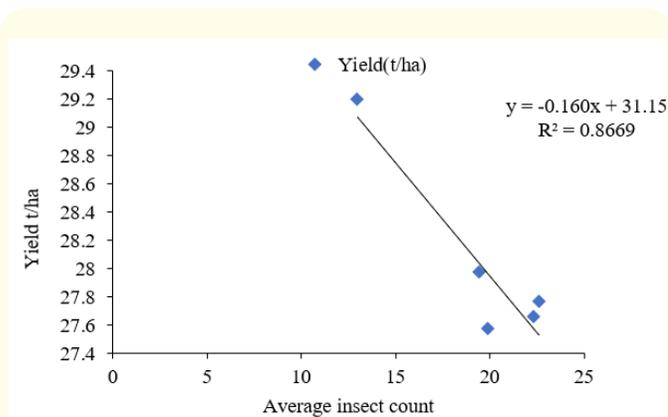
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Figure 1: ERelationship between Average insect count and Yield (t/ha) at Kaski, 2018.

reduction of yield could have been caused by the intercrop competition for nutrients, water and light.

Effect of intercropping on yield per plot(t/ha)

The yield of okra per plot was significantly different in all the treatments. The highest yield (28.20t/ha) was found in okra intercropped with coriander which is followed by okra intercropped with fennel (27.97 t/ha). The lowest yield per plot (27.77 t/ha) was found in control followed by okra intercropped with parsley (27.66 t/ha) and okra intercropped with carrot (27.58 t/ha).

Abdelkader and Mohsen [12] it is found that intercropping pattern of 1 coriander: 2 onions gave the highest values of onion NPK uptake and protein content per bulb. The highest yield per plot in coriander used as intercrop is due to decreased pest attack than other treatments. This result is in the agreement to Shri., *et al.* (1998) who earlier reported that the purpose of any sound pest management by intercropping is not only to reduce pest population but equally reduce loss of crop yield and quality [13].

Effect of intercropping in yield parameters
Effect of intercropping on average pod length(cm) of okra

The pod length was significantly different among all the treatments. The highest average pod length (17.92 cm) was obtained when okra was intercropped with coriander. The average pod length in all other treatments was statistically similar.

This can be supported by Ahmed., *et al.* (2004) who stated that the good performance of okra plant under intercropping arrangement is probably because of the low population trend of okra pests in the intercropped plots while the possible reasons for the poor performance of okra plant in sole cropped plots may be attributed to the high population of okra pests. The lowest population of jassid and whitefly when okra is intercropped with coriander might be the reason for the highest pod length.

Effect of intercropping on average number of fruits per plant

The average number of fruits per plant was highly significant in all the treatments. The highest average number of fruits per plot (15.75) was observed when okra was intercropped with coriander. The lowest average number of fruits per plant (12.25) was found when okra was intercropped with carrot. The highest yield of okra in treatment when okra was interrupted with coriander may be due to less damage by insects to okra leaves.

The least yield was observed in treatment where carrot is used as intercrop. Ofosu-Anim and Limbani [11] observed the 60% yield reduction in bulb of onion when intercropped with carrot and the

Treatments	Average pod length (cm)	Average number of fruit per plant	Yield per plot (t/ha)
Okra only(control)	16.96[b] ± 0.44	14.50[b] ± 0.65	27.77[bc] ± 0.48
Okra + Coriander	17.92[a] ± 0.57	15.75[a] ± 0.48	29.20[a] ± 0.49
Okra + Carrot	16.42[b] ± 0.21	12.25[c] ± 0.48	27.58[c] ± 0.39
Okra+ Fennel	16.75[b] ± 0.32	14.25[b] ± 0.48	27.97[ab] ± 0.46
Okra+ Parsley	16.74[b] ± 0.26	14.00[b] ± 0.41	27.66[c] ± 0.51
F test	*	***	**
LSD$_{0.05}$	0.943	0.783	0.288
CV (%)	3.60	3.592	0.672

Table 3: Effect of different intercropping system in average pod length (cm), average number of fruits per plant and yield per plot (t/ha) at Lekhnath-27, Kaski, 2018.

DAS: Days after sowing, cm: centimeters, LSD: Least significant difference, t/ha: tons per hectare, CV: Coefficient of variation, Value with same letters in the column is not significantly different at 5% by DMRT and a figure after ± indicates standard error.

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Economics of okra production when intercropped

Economics of production was calculated for each treatment. The total revenue was collected from main crop as well as inter-crops. The cost incurred in Labor and Fertilizer was same for each treatment. However the cost of seed was different in different treatments except the main crop. The cost and returns were based on local and standard market price at Pokhara-Lekhnath Municipality on 10th June 2018. Total revenue collected from each treatment, cost incurred in each treatment and Benefit cost ratio is presented in table 4.

Treatments	Total revenue	Total cost	B:C
Okra only	1381222.222	1710438	0.81
Okra + Coriander	3136319.444	1043771	3.00
Okra + Carrot	2067083.333	988215.5	2.09
Okra+ Fennel	1795868.056	1015993	1.76
Okra+ Parsley	1802777.778	1571549	1.14

Table 4: Total revenue, Total cost and benefit cost ratio in different intercropping systems in Lekhnath-27, Kaski, 2018.

The highest benefit cost ratio (3.00) was obtained in okra intercropped with coriander followed by carrot (2.09). The lowest benefit cost ratio (0.81) was obtained in control.

Conclusion

When okra vegetable was intercropped with coriander the numbers of insects-jassids and whiteflies were significantly lower than other intercrop combinations. The yield of okra was also the highest when it was intercropped with coriander with highest benefit cost ratio. So, okra intercropped with coriander was found beneficial in terms of low insect pest population of okra in Kaski district

Bibliography

1. Mote UN. "Active and feeding period of onion thrips and proper time of application of endosulfan for their control". *Journal of Vegetation Science* 5 (1977): 143-144.

2. Ragumoorthi KN and Kumar S. "Biophysical factors of Bhendi, Abelmoschus esculentus (L.) Moench. Offering resistance to leaf hopper Amrasca biguttula biguttula (Ishida) cicadellidae: Homoptera". Pestology 23 (2000).

3. Sujayanand GK., *et al*. "Crop diversification for sustainable insect pest management in eggplant (Solanales: Solanaceae)". *The Florida Entomologist* (2015): 305-314.

4. Wagan TA. "Natural enemies associated with jassid on okra crop under natural agroecosystem". *Advances in Life Science and Technology* (2015).

5. Togni, P., *et al*. "Odour masking of tomato volatiles by coriander volatiles in host plant selection of Bemisia tabaci biotype B. Entomologia Experimentalis et Applicata (2010): 164-173.

6. Mann R., *et al*. "Repellancy and toxicity of plant based essential oils and their constituents against Diaphorina citri Kuwayama (Hemiptera; Psyllidae)". *Journal of Applied Entomology* (2010).

7. Ngoh SP., *et al*. "Insecticidal and repellent properties of nine volatile constituents of essential oils against the American cockroach. Periplaneta americana (L.)". *Journal of Pesticide Science* 54 (1998): 261-268.

8. Ukeh DA., *et al*. "Effects of plantain inflorescence ash and neem seed extracts on the yield and insect pests of egg plant (solanum melongena) in Calabar, Nigeria". *World Research Journal of Agronomy* 1 (2007): 88-93.

9. Sfara V., *et al*. "Fumigant insecticidal activity and repellent effect of five essential oils and seven monoterpenes on first-instar nymphs of Rhodnius prolixus". *Journal of Medical Entomology* 46 (2009): 511-515.

10. Hilje P and Stansly L. "Living ground covers for management of Bemesia tabaci (Gennadius) (Homoptera: Aleyrodidae) and tomato yellow mottle virus in Costa Rica". *Crop Protection* (2008): 10-16.

11. Ofosu-Anim J., *et al*. "Effect of intercropping on the growth of cucumber and okra as affected by intercropping". *International Journal of Agriculture and Biology* 9 (2007): 594-597.

12. Abdelkader MA and Mohsen A. "Effect of intercropping patterns on growth, yield components, chemical constituents and comptation". *Zagazig Journal of Horticultural Science* (2016): 67-83.

13. Okra Abelmoschus escullentus L. "Moench (Malvaceae) is an important vegetable cultivated for domestic consumption and for export. The major constraint in increasing the productivity of okra is insect pests, viz., leafhopper.