



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(6): 2146-2148
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www.thepharmajournal.com
Received: 01-04-2022
Accepted: 06-05-2022

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Effect of different intercrops with cabbage on DBM (*Plutella xylostella*) pest population

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Abstract

The effect of different intercrops with cabbage on DBM (*Plutella xylostella*) pest population was studied during the year 2016-17 and 2017-18 at Rajnandgaon district of Chhattisgarh. The incidence of DBM was recorded at fourth, fifth, sixth, seventh and eighth weeks after transplanting (WAT) in different intercrops. On the basis of pooled mean the overall impact of different intercrops, the cabbage + onion (2:1) was most effective intercrop with reducing DBM population (1.08 larvae plant⁻¹), maximum cabbage yield (197.79 q ha⁻¹), cabbage equivalent yield (273.32 q ha⁻¹) and maximum cost benefit ratio (1:3.08).

Keywords: DBM, diamondback moth and intercrops

Introduction

Cabbage (*Brassica oleracea* var. *capitata*) is an important vegetable crop of cruciferous family (Brassicaceae), widely grown in the country. Cabbage is also endowed with many health benefits. In fact, cabbage is rich in various phytonutrients, Ca, P, Na, K, S, Vitamin 'A' and 'C' along with dietary. These all are natural antioxidants, which help to prevent cancer and heart disease-inducing free radicals. The nutritional capacity of 100 g of cabbage provides 5.8 g of carbohydrates, 2.5 g dietary fibre, 1.3 g protein, 0.1 g fat, 36.6 mg vitamin C (44% of daily requirement), 76 mg vitamin K (72% of daily requirement) (Anonymous, 2017) [1]. India is the world's second-largest producer of vegetables next to China. In Chhattisgarh, cabbage cultivation was done in 22142 hectares area with the production of 426078 metric tons. (Anonymous, 2020) [2].

The concept of intercropping involves the cultivation of two or more crops simultaneously on the same field. The rationale behind intercropping is that the different crops planted are not likely to be attacked by the same pests. The commonest goal of intercropping is to produce a greater yield on a given piece of land, making use of resources that would otherwise not be utilized by a single crop. Intercropping reduces pest population because of the diversity of crops grown. When other crops are present in the field pests movements are hindered. According to Sullivan (2003) [11], if susceptible plants are separated by non- host plants that can act as a physical barrier to the pest, the susceptible plant will suffer less damage. The use of synthetic chemical insecticides have been effective in controlling pests, but the continuous use pose harmful effects like residual contamination of the produce, environmental pollution as well as pest resistance. There is therefore the need to seek alternative methods of managing pests.

According to the Trenbath (1993) [12] intercropping for the management of pests and diseases recorded that intercrops were often less damaged by various pest and disease organisms than when crop was cultivated as sole planting. Intercropping of cabbage with garlic, coriander, marigold, onion, tomato etc. plant species are reported to either repel or make host finding difficult for the pest could be an effective approach for managing *Plutella xylostella* on cabbage (Wage, 1990) [13]. The beneficial effect of intercropping is increasing due to crop equivalent yield and repelling the targeted insects thus declined the chemical effect on the crop as well as soil system. The benefits of intercropping include better utilization of space between two rows, declined pest population, enhanced predator and parasitoid activity and increased weed suppression as reported by Callum, 2007 [5]. Integration of appropriate intercropping system not only reduced pest population but also enhancement of productivity as well as profitability. Keeping this in view impact of different intercrops with cabbage against DBM pest population was studied at Rajnandgaon district of Chhattisgarh.

Materials and Methods

For effect of different intercrops with cabbage against DBM pest population was studied at Pt. KLS, CHRS, Rajnandgaon, Chhattisgarh during November to March of two consecutive years i.e. 2016-17 and 2017-18. The intercrops *viz.* garlic and coriander were sown directly in the main field while, other intercrops i.e. tomato, onion and marigold were sown in nursery bed for transplanting. Two rows of main crop and one row of intercrop were transplanted. After four weeks, old cabbage seedlings were transplanted, fourteen days after planting of the intercrops. Interspace between cabbage plants were 0.60 meter with intra row spacing of 0.45 meter. After two weeks of cabbage transplanting eight healthy plants were randomly selected at the rate of four plants per rows in each plot. For collection of data, plants were carefully examined and the numbers of larvae DBM were recorded. This observation was repeated weekly till harvesting of crop. At harvest, yield of cabbage head was recorded from each plot. In intercropping system, cabbage equivalent yield was calculated by using formula as described by Kumar *et al.* (2009)^[7].

$$\text{Cabbage equivalent yield (CEY) q ha}^{-1} = \frac{\text{Yield of intercrop (q ha}^{-1}) \times \text{Cost of intercrop (Rs q}^{-1})}{\text{Cost of cabbage crop (Rs q}^{-1})}$$

Results and Discussion

Cabbage is an important leafy vegetable which forms an important component of the diets. However increased production of this crop is being hindered by pests' attack. By the inclusion of suitable intercropping system, intercrops act as physical barriers to the movement of insect pests ultimately declined pest incidence (Root, 1973)^[8]. In the study, the impact of intercrops with cabbage against incidence of DBM was recorded at seven days interval after fourth week of transplanting of main crop (cabbage). On the basis of pooled mean of two consecutive years *i.e.* 2016-17 and 2017-18, the incidence of diamondback moth on different intercrops was observed that significantly least larval population of 1.08 larvae plant⁻¹ recorded on intercrop cabbage + onion (2:1). Intercrop cabbage + garlic (2:1) was recorded as second best combination with respect to lower population of DBM with 1.27 larvae plant⁻¹ (Table 1). Cabbage intercrop with marigold (2:1), coriander (2:1) and tomato (2:1) recorded 1.62, 1.79 and 1.96 larvae plant⁻¹, respectively. However, the maximum population of DBM (2.15 larvae plant⁻¹) was recorded on sole crop. The result revealed that the population of DMB was found least in cabbage intercrop with onion and garlic crops

as compare to other intercrops, it might be possible due to onion and garlic produced compounds such as allicin and allyl-propyl-disulphide, respectively which create repellent effect on insect pests of cabbage. Intercropping of cabbage with onion and garlic able to repel *Plutella xylostella* due to presence of some pungent alliaceous compound *viz.* allyl-propyl-disulphide (Said and Itulya 2003)^[9]. Sheehan (1986)^[10] also reported that the chemical or visual communication between the pest and host is disturbed when the use of intercrop with main crops.

In cabbage one important factor that determines the marketability of the crop is the extent of damage to the head. Cabbage heads that are heavily infested by pests are less attractive to buyers. Maximum yield of 197.79 q ha⁻¹ was obtained when cabbage intercropped with onion (2:1) followed by cabbage + garlic (2:1), cabbage + marigold (2:1), cabbage + coriander (2:1), cabbage + tomato (2:1) and cabbage sole with 194.75, 192.22, 190.88, 185.61 and 179.11 q ha⁻¹, respectively. Whereas, the yield of intercrops was recorded with 50.35, 21.89, 42.23, 2.10 and 48.39 q ha⁻¹ in onion, garlic, marigold, coriander and tomato, respectively (Table 2). While cabbage equivalent yield (CEY) was calculated and the highest CEY of 273.32 q ha⁻¹ was cabbage + onion (2:1) followed by cabbage + garlic (2:1), cabbage + coriander (2:1), cabbage + marigold (2:1), and cabbage + tomato (2:1) with 263.16, 245.01, 222.30 and 221.90 q ha⁻¹, respectively.

The highest C:B ratio was obtained from intercrop cabbage + onion (2:1) with 1:3.08 and followed by cabbage + garlic (2:1), cabbage + coriander (2:1), cabbage + marigold (2:1) and cabbage + tomato (2:1) with 1:2.93, 1:2.69, 1:2.51 and 1:2.48, respectively (Table 3). The present investigation is confirmatory with the findings of Debra and Misheck (2014)^[6] noticed that intercropping cabbage with onion and garlic significantly reduced pest perpetuation and increased cabbage yield compared to sole planting of cabbage crop. Asare *et al.* (2010)^[3] also observed that intercropping of cabbage + onion recorded minimum leaf damage and mean DBM population *viz.* 2.50 and 1.7, respectively. Baidoo *et al.* (2012)^[4] who was also observed that the intercropping of cabbage with onion suppresses the population of DBM due to the presence of strong aroma like allyl-propyl-disulfide (volatile sulfur compound) that modify pest behavior compared to other intercrops. Kumar *et al.* (2009)^[7] observed that cabbage + garlic (1:2) intercropping had the lowest DBM infestation registering 2.78, 3.60, 4.63, 4.20 and 2.98 larvae plant⁻¹ on various days of intervals (21, 28, 35, 42 and 49 DAT) and maximum cabbage equivalent yield was 208 q ha⁻¹.

Table 1: Incidence of DBM on cabbage with different intercrops during 2016-17 and 2017-18 (Pooled mean)

Treatment	Incidence of diamondback moth, <i>P. xylostella</i> (Numbers of larvae plant ⁻¹)					Mean
	4 WAT	5 WAT	6 WAT	7 WAT	8 WAT	
Cabbage + Garlic (2:1)	0.56 (1.25)	0.83 (1.35)	1.42 (1.56)	1.69 (1.64)	1.84 (1.69)	1.27 (1.51)
Cabbage + Coriander (2:1)	0.91 (1.38)	1.59 (1.61)	1.88 (1.70)	2.17 (1.78)	2.41 (1.85)	1.79 (1.67)
Cabbage + Marigold (2:1)	0.83 (1.35)	1.33 (1.52)	1.66 (1.63)	2.00 (1.73)	2.28 (1.81)	1.62 (1.62)
Cabbage + Tomato (2:1)	1.05 (1.43)	1.75 (1.65)	2.03 (1.74)	2.38 (1.84)	2.58 (1.89)	1.96 (1.72)
Cabbage + Onion (2:1)	0.42 (1.19)	0.63 (1.28)	1.23 (1.50)	1.34 (1.53)	1.75 (1.66)	1.08 (1.44)
Cabbage sole	1.06 (1.43)	1.88 (1.69)	2.20 (1.79)	2.56 (1.89)	3.05 (2.01)	2.15 (1.78)
SEm±	0.02	0.03	0.01	0.01	0.02	0.01
CD (p=0.05)	0.06	0.10	0.02	0.02	0.05	0.02

Note: Figures in parentheses are square root transformed values, WAT= Weeks after transplanting

Table 2: Yield of main crop (cabbage), different intercrops and cabbage equivalent yield (CEY) due to DBM incidence during 2016-17 and 2017-18

Treatment	Yield (q ha ⁻¹)								
	2016-17			2017-18			Pooled mean		
	Main crop (cabbage)	Inter-crops	CEY	Main crop (cabbage)	Inter-crops	CEY	Main crop (cabbage)	Inter-crops	CEY
Cabbage + Garlic (2:1)	196.55	23.59	270.27	192.95	20.19	256.04	194.75	21.89	263.16
Cabbage + Coriander (2:1)	192.83	2.24	226.43	188.92	1.95	218.17	190.88	2.10	222.30
Cabbage + Marigold (2:1)	194.77	43.71	249.41	189.68	40.74	240.61	192.22	42.23	245.01
Cabbage + Tomato (2:1)	186.72	52.49	226.09	184.50	44.28	217.71	185.61	48.39	221.90
Cabbage + Onion (2:1)	198.68	51.03	275.23	196.91	49.67	271.42	197.79	50.35	273.32
Cabbage sole	179.56			178.66			179.11		
SEm±	0.63			0.41			0.85		
CD (p=0.05)	2.01			1.49			2.70		

Table 3: Yield and economics of different treatment due to DBM incidence (Average of two year data)

Treatment	Yield of cabbage (main crop) (q ha ⁻¹)	Yield of intercrop (q ha ⁻¹)	Cabbage equivalent yield (CEY) (q ha ⁻¹)	Cost of main crop and intercrops (Rs ha ⁻¹)	C:B ratio
Cabbage + Garlic (2:1)	194.75	21.89	263.16	71900	2.93
Cabbage + Coriander (2:1)	190.88	2.10	222.30	70800	2.51
Cabbage + Marigold (2:1)	192.22	42.23	245.01	73000	2.69
Cabbage + Tomato (2:1)	185.61	48.39	221.90	71500	2.48
Cabbage + Onion (2:1)	197.79	50.35	273.32	71000	3.08
Cabbage sole	179.11				

*Sale price of cabbage = Rs 800 q⁻¹, Garlic = Rs 2500 q⁻¹, Coriander = 12000 q⁻¹, Marigold = 1000 q⁻¹, Tomato = 600 q⁻¹ & Onion = 1200 q⁻¹

Conclusion

The results of this study indicated that onion can be used as an intercrop in the management of cabbage pests. The fact that reduction in pests' numbers and significant increase in yield were achieved without the use of insecticides was an indication that when adopted by the small to medium scale farmer it would improve yield and increase the incomes of farmers. On the basis of pooled mean the overall impact of different intercrops, the cabbage + onion (2:1) was most effective intercrop with reducing DBM population (1.08 larvae plant⁻¹), maximum cabbage yield (197.79 q ha⁻¹), cabbage equivalent yield (273.32 q ha⁻¹) and maximum cost benefit ratio (1:3.08). Hence intercropping every two rows of cabbage with one row of onion will serve as an effective pest management strategy and effective land use.

Acknowledgement

The authors express his heartfelt gratitude to Dr. V. K. Dubey and Dr. R. N. Ganguli, Professor, Department of Entomology for giving me help and financial assistance during the successful conduction of the experiment.

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