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Usefulness of intercrops in management of African Bollworm, *Helicoverpa armigera* Hubner in chickpea, *Cicer arietinum* L. in Ethiopia

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ABSTRACT

Field trial was conducted to study the effect of intercropping in chickpea, *Cicer arietinum* L. with eight different crops *viz.* wheat, barley, lentil, linseed, rapeseed, coriander, garlic, African marigold against *Helicoverpa armigera*. Each intercrop was sown in randomized complete block design with three replications. Observations were collected on number of eggs and larvae/10 plants, per cent larval parasitization, per cent pod damage and ultimately yield (Kg/ha). Results of two years study revealed that chickpea + African marigold was found to be the most effective treatment in reducing egg laying and larval population followed by chickpea + rapeseed. The maximum per cent of larval parasitization by *Campoletis chlorideae* was observed in chickpea + coriander followed by chickpea + linseed, however, it was minimum on intercrops *i.e.* wheat and rapeseed. Pod damage was significantly reduced in treatments, chickpea intercropped with coriander and African marigold by 83.05 and 64.96 per cent, respectively, over chickpea as sole crop. The highest yield was recorded in chickpea + coriander followed by chickpea + African marigold among the different tested treatments. Chickpea intercropped with lentil, garlic and linseed gave minimum yield which was lower than check (chickpea sole).

Key words: African bollworm, *Helicoverpa armigera*, Chickpea, Intercrops, Pod Damage, Parasitization, Yield

Chickpea (*Cicer arietinum* L.) is an important source of protein for millions of people in developing countries. Ethiopia is a largest producer of chickpea in Africa accounting for about 46 per cent of production during 1994-2006 (EARI 2006) and seventh largest producer in worldwide (Jones *et al.* 2006). African bollworm (ABW), *Helicoverpa armigera* is a pest of major significance in most of the areas wherever it occurs, damaging a wide variety of food, fiber, fodder and horticultural crops. In Ethiopia, African bollworm causes pod damage on chickpea with varied magnitude in different areas for instance 21-36 per cent in central highlands (Gelatu and Million 1996), 100 per cent in some localities of Yilmana Densa and Achefer areas in Gojjam in the 1990s (Melaku *et al.* 1998) and overall 8-10 per cent (Shegaw 2002). Worldwide, *Helicoverpa* species possibly cause an estimated loss of US$ 7.5 billion in different crops, despite the application of insecticides costing about US$ 2 billion annually (Gowda and Sharma 2005). So far, most of the African bollworm control practices adopted or recommended in Africa are limited to individual target crop, and predominantly based on the use of chemical pesticides. Since such pesticide-dependent approach is not sustainable, thus there exists a need to provide farmers with safer alternatives (Sithanantham and Baumgartner 2001). Intercropping is one such method, generally understood to mean the growing of a mixture with main crop which can affect microclimate of the agro-ecosystem and ultimately produce an unfavorable environment for insect-pests. Although some works have been reported on effect of intercropping with different crops in reducing insect-pests damage (Yadav *et al.* 1989, Kumar *et al.* 2008), but none has reported the effectiveness of intercrops with chickpea in Ethiopia. Thus, the present study was conducted to study the effect of different crops as intercrop with chickpea to manage gram African Bollworm.

MATERIALS AND METHODS

The chickpea, *C. arietinum* (variety Worku) was sown in 5x3 m plot size and the ratio with intercrops was 3:1 except the sole crop during 2009-10 and 2010-11. Nine treatments including eight intercrops *i.e.* wheat, *Triticum aestivum* (Jiru); barley, *Hordeum vulgare* (HB-1307); lentil, *Lens culinaris* (Teshale); linseed, *Linum usitatissum* (Tolle); rapeseed, *Brassica* sp. (Holetta-1); coriander, *Coriandrum sativum* (Walta-I); garlic, *Allium sativum* (Bishoftu Netch); african marigold, *Tagetes erecta* were used with check (chickpea sole). Each treatment was randomized by three replications in randomized complete block design. Plant population density was maintained by row to row and plant to plant spacing. Row spacing was maintained by 30cm in all treatments including check. Plant to plant distance was maintained at 10cm in rows of chickpea, rapeseed, coriander and garlic; 5cm in wheat, barley, lentil and linseed and 45cm in A. marigold. All the recommended agronomic practices were followed. Natural infestation of *H. armigera* was recorded from each replication of all nine treatments to check the effectiveness of intercrops.

Number of eggs and larvae were counted from 10 randomly selected plants in the morning and it was taken at three days interval from commencement of the infestation. Ten second instar African bollworm larvae from each replication of the treatments were collected once and reared separately in the laboratory and the level of parasitization was recorded. In order to assess per cent pod damage, ten randomly selected plants were uprooted at harvesting stage by counting the healthy and infested pods. Percent reduction of pod damage over chickpea sole crop was calculated as per the method given by Abbott (1925):

Percent reduction of pod damage over sole crop= T-C/C × 100

Where, C= percent pod damage in chickpea sole crop

T= percent pod damage in intercrops

Yield was taken after harvesting the crop in Kg/ha.

RESULTS AND DISCUSSION

Results of the present study revealed that chickpea intercropped with african marigold was found most effective in reducing the egg laying (5.1 eggs/10 plants) of *H. armigera* followed by 6.15 eggs/10 plants in chickpea + rapeseed (Table 1). The highest egg laying was recorded in chickpea sole (14.1eggs/10 plants) followed by chickpea + garlic (13.8 eggs/10 plants) and chickpea + lentil (13.15 eggs/10 plants). Srinivasan *et al.* (1994) reported marigold used as a trap crop reducing the egg laying of *H. armigera* in Tomato. In the year 2010-11, number of eggs and larvae recorded were comparatively higher than 2009-10 in all the treatments, it might be due to heavy rain with wind during reproductive stage of the chickpea crop and eventually temperature was decreased. In case of larval population, pooled data of two years showed that chickpea + marigold and chickpea + rapeseed was again found to be most effective in reducing larval infestation with 4.65 and 5.8 larvae/10 plants, respectively. In check, 14.6 larvae/10 plants were recorded during 2010-11 which was statistically at par with chickpea + garlic and chickpea + lentil. Other treatments had a significant effect in the reduction of larval population. Chickpea + marigold as most effective intercrop to reduce larval population of *H. armigera* was also strengthened by Kumar *et al.* (2008).

Pooled data of two years study on percent larval parasitization by *Campoletis chlorideae* was recorded maximum (41.8%) in chickpea + coriander (Table 1). Our findings are in conformity with the investigation of Rao *et al.* (1990) for coriander as best intercrop, because of higher activity of larval parasitoids attracted to the umbelliferae at flowering stage. The treatments (11.6-43.6% larval parasitization) were statistically significant from check (8.6%) and chickpea + wheat (10.6%) during 2010-11. The average minimum parasitization of both the years was recorded in chickpea sole (7.95%). Percent parasitization was recorded higher in the year 2010-11 as compared to 2009-10, it might be due to higher larval population in 2010-11.

The highest pod damage *i.e.* 36.6 per cent was observed in chickpea sole and there was no significant difference was found in intercrops *i.e.* lentil (35.6%) and garlic (33.6%) with check in the year 2010-11. Percent reduction of pod damage over chickpea sole crop was found maximum in chickpea+ coriander (83.05%) followed by chickpea+ A. marigold (64.96%), whereas, minimum (2.85%) was in chickpea+ lentil (Table 2). Chickpea intercropped with linseed, wheat and mustard having low pod damage than sole crop was also reported by earlier workers (Yadav 1987 and Yadav *et al.* 1989).

Table 1. Effect of Intercropping on number of eggs, larvae and per cent larval parasitization of African bollworm, *H. armigera*

Treatments	Eggs/10 plants			Larvae/10 plants			Larval parasitization (%)		
	2009-10	2010-11	Mean	2009-10	2010-11	Mean	2009-10	2010-11	Mean
Chickpea + Wheat	7 (0.85)	9.3 (0.97)	8.15	6.0 (0.78)	7.3 (0.86)	6.65	9.3 (17.5)	10.6 (19)	9.95
Chickpea + Barley	7.6 (0.89)	9.6 (0.98)	8.6	7.3 (0.86)	8.6 (0.93)	7.95	10.3 (18.7)	13.3 (21.2)	11.8
Chickpea + Lentil	12.3 (1.09)	14 (1.15)	13.15	12 (1.08)	14 (1.15)	13	11.3 (19.6)	12.6 (20.8)	11.95
Chickpea + Linseed	9.6 (0.98)	10.9 (1.03)	10.25	8.6 (0.93)	10.3 (1.01)	9.45	29.3 (32.6)	33.3 (34.6)	31.3
Chickpea + Rapeseed	5.3 (0.72)	7 (0.85)	6.15	5 (0.70)	6.6 (0.82)	5.8	9.6 (18.4)	11.6 (19.8)	10.6
Chickpea + Coriander	7.3 (0.86)	9 (0.95)	8.15	7 (0.85)	8.3 (0.92)	7.65	40.3 (39.3)	43.6 (40.3)	41.8
Chickpea + Garlic	13 (1.14)	14.6 (1.16)	13.8	12.9 (1.11)	14.3 (1.16)	13.6	11.6 (19.8)	12.3 (20.7)	11.95
Chickpea+A. marigold	4.3 (0.63)	5.9 (0.77)	5.1	4 (0.60)	5.3 (0.72)	4.65	10.6 (19)	12.6 (20.7)	11.6
Chickpea (sole)	13.3 (1.12)	14.9 (1.73)	14.1	13 (1.11)	14.6 (1.16)	13.8	7.3 (15.6)	8.6 (15)	7.95
CD at 5%	1.57	1.72		1.79	1.88		2.33	2.37	

Data given in Parenthesis for eggs/10plant and larvae/10 plants are square root transformed values and for larval parasitization (%) are angular transformed values.

Table 2. Effect of Intercropping on pod damage and yield against African bollworm, *H. armigera*

Treatments	Pod damage (%)			Yield (kg/ha)		
	2009-10*	2010-11*	Mean (% redcn. over check)	2009-10	2010-11	Mean
Chickpea + Wheat	20.3 (26.8)	23.6 (29)	21.95 (34.46)	1325	1280	1302
Chickpea + Barley	19.6 (26.3)	23.0 (28)	21.3 (39.32)	1420	1385	1402
Chickpea + Lentil	32.6 (34.8)	35.6 (36.6)	34.1 (2.85)	1038	996	1017
Chickpea + Linseed	20.6 (27)	23.3 (28.8)	21.95 (37.46)	1126	1047	1086
Chickpea + Rapeseed	19.3 (25.7)	22.6 (28.4)	20.95 (40.31)	1417	1382	1399
Chickpea + Coriander	5.6 (13.6)	6.3 (14.5)	5.95 (83.05)	1675	1635	1655
Chickpea + Garlic	31.3 (33.9)	33.6 (35.5)	32.45 (7.55)	1047	1009	1028
Chickpea+A. marigold	11.3 (19.6)	13.3 (20.4)	12.3 (64.96)	1486	1456	1471
Chickpea (sole)	33.6 (35.5)	36.6 (27.3)	35.1 (----)	1137	1093	1115
CD at 5%	3.19	3.32		157.56	141.32	

*Data given in Parenthesis are angular transformed values.

Yield (Kg/ha) of chickpea intercropped with coriander (1635), A. marigold (1456), barley (1385), rapeseed (1382) and wheat (1280) were recorded statistically significant higher in comparison to lentil (996), garlic (1009) and chickpea sole (1093) during 2010-11(Table2). The average maximum yield of 2009-10 and 2010-11 was also found in chickpea + coriander (1655 Kg/ha) followed by chickpea + A. marigold (1471 Kg/ha) because least pod damage and maximum larval parasitization were recorded on coriander as intercrop. African marigold was found second most effective intercrop in terms of yield and pod damage, whereas per cent larval parasitization was recorded low as compared to linseed, lentil, barley and garlic. Lentil as intercrop gave minimum yield due to high incidence of eggs, larvae and pod damage, with lower parasitization of larvae. Shekhar *et al.* (1995) reported increase in yield to different levels when chickpea was intercropped with different crops against chickpea as sole. On the basis of present findings, coriander and African marigold is recommended as best intercrops with chickpea in reducing the African bollworm damage.

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