

Efficacy of plant extracts in the suppression of insect pests and their effect on the yield of sunflower crop under different climatic conditions

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A B S T R A C T

Sunflower (*Helianthus annuus* L.) is an annual herb scarcely cultivated in Bangladesh. During cultivation, the coccinellid beetle, *Epilachna varivestis* (Coleoptera: Coccinellidae) severely attacked the foliage and florets in the capitulum (inflorescence). Other pests encountered were *Spilosoma obliqua* (Walker) (Lepidoptera: Arctiidae), *Homoeosoma* sp. (Lepidoptera: Phyticidae), *Heliothis armigera* (Hb.) (Lepidoptera: Noctuidae), *Monolepta signata* (Oliv.) (Coleoptera: Chrysomelidae) and *Epilachna septima* Dieke. (Coleoptera: Coccinellidae). The efficacy of five kinds of plant extracts or botanicals viz., Neem (*Azadirachta indica*) seed oil, castor (*Ricinus communis*) oil, a mixture of Neem seed oil and sesame oil, leaf extracts of custard apple (*Annona squamosa*) and Bara Bishkatali (*Polygonum orientale*) were tested against the pest infestation. The treatment of custard apple leaf extract produced the most favourable result in respect of pest control and crop yield. The other treatments also exhibited better results in comparison to control followed by Bara Bishkatali, Neem seed oil, a mixture of Neem seed oil and sesame oil, and castor oil. The yield was 10.8 and 12.0 maunds per acre in the crop fields of Lalmonirhat and Rajshahi Oilseed cultivation Centres, respectively.

Keywords: Plants extracts, insectpests, sunflower Bangladesh, botanical insecticides.

Introduction

Sunflower is one of the most important cholesterol free edible oils in the world. It does not contain harmful erucic acid but possesses linoleic acid which is beneficial to our health (Rikabder 1987). It is an essential element of butter and margarine. The linoleic acid obtained from sunflower oil shows anti-carcinogenic effects (Bauman *et al.* 2000). The crop can be grown in dry areas in a variety of soils. Sunflower is attacked by a number of insect pests viz., Epilachna beetle, *Epilachna varivestis* Muls., red hairy caterpillar, *Homoeosoma* sp., noctuid caterpillars, *Heliothis armigera* (Hb.) and Spodoptera

litura (F.), epilachna beetle, *Epilachna septima* Dieke, white-spotted leaf sucking coleopteran beetle, *Monolepta signata* and hemipteran stink bug, *Nezara viridula* (L.) (Hill 1983; Horvath 1993; Ahmed 2002; Vasilijevic & Glusac 1994; Reddy *et al.* 1991; Marin 1992). Natural plant materials or plant extracts can successfully control major stored product insects (Islam 1987; Talukder *et al.* 1998). According to Feinstein (1952), over 2000 species of plants representing 170 families are said to have been some insecticide properties. So, the present paper deals with the suppression of the pests of sunflower by spraying different plant extracts.

Materials and Methods

The experiments on pest control of sunflower through the application of biopesticide (compatible plant extracts) were conducted during the crop seasons of 2001-2002 in two climatic conditions i.e., northern region (Patgram Oilseeds Cultivation Centre, Lalmonirhat) and western region (BCSIR Laboratories Oilseeds Cultivation Centre, Rajshahi). Sunflower is an inflorescence and its seeds are called 'achenes'. Usually one inflorescence is grown in each plant.

Prior to outbreak of severe pest infestation (i.e., minor pest occurrence), five botanicals or plant extracts viz., Bara Bishkatali leaf extract, Neem seed oil , sesame oil, castor oil and a mixture of Neem seed oil and sesame oil were sprayed in the northern Oilseeds Cultivation Centre, Patgram, Lalmonirhat. Sunflower seeds were sown in two seasons namely, winter season (November, 2001) and late winter season (February, 2002) in this centre. In the BCSIR Lab Oilseeds Cultivation Centre of the western region, Rajshahi four different plants extracts viz., custard apple, Bara Bishkatali leaf extracts, Neem seed oil and a mixture of Neem seed oil and sesame oil were applied during the onset of pest infestation. The control plots were maintained in both the oilseed cultivation fields where plants extracts were not sprayed.

The plant parts of desired botanicals were finely chopped into small pieces, air dried, pounded in mortar and pestle into a coarse powder and were finally grounded into fine powders which were subjected to extraction of insecticides in methanol solvent kept in different air tight

bottles. Original extracts, in 5% solution dissolved in water, were used for spraying in sunflower crop fields to control the insect pests.

The insect pests in both the sunflower fields of Patgram and BCSIR Centres were collected at fortnightly interval and preserved in 80 % ethyl alcohol with a drop of glycerine for future study. The status of pest occurrence in sunflower crop fields before and after spraying of botanicals was carefully observed. The data on the yield of seed per plant (inflorescence), size of inflorescence, plant height and number of seeds per plant were recorded. Chemical fertilizers and cow-dung were supplied in the sunflower crop fields of both the regions following recommended guideline. The prevailing field temperatures, relative humidities and other weather parameters during oilseed cultivation were also recorded for comparison of pest occurrence.

Results and Discussion

The effect of different plant extracts or botanicals on the size of the inflorescence disc (sq. cm) per plant in the late sowing plot of sunflower and yield per plant showed insignificant value due to the increasing temperature in the month of February, 2005. This means that there is no impact of different plant extracts on the size of flower disc. Common fungal disease did not occur in the sunflower plants of late sowing season compared to that sown in winter season. The applied plant extracts produced significant results ($P < 0.05$) indicating that yield of sunflower per plant increased with the botanicals sprayed in the crop fields (Table1).

Among the applied extracts, Bara Bishkatali leaf extract produced the best result.

Table 1.
Effect of different plant extracts on the yield of sunflower at BCSIR and Patgram oilseed cultivation centres

Treatment	Yield of sunflower (g) per plant (BCSIR Centre, Rajshahi)		Yield of sunflower (g) per plant (Patgram Centre, Lalmonirhat)		F (Critical value)	Variance ratio (F) Significant/Insignificant (P < 0.001)
	Total	(Mean ± S.E)	Total	(Mean ± S.E)		
Control	294.2	29.42 ± 8.604	284.2	28.42 ± 9.77	2.35605	Insignificant
5% <i>Polygonum orientale</i> leaf	526.8	52.68 ± 25.78	350.1	35.01 ± 14.52	2.38607	Significant
5% <i>Annona squamosa</i> leaf	489.1	48.91 ± 12.88	-	-	2.386066	Significant
5% <i>Melia azadirachta</i> seed oil	376.2	37.62 ± 16.12	242.2	24.22 ± 10.48	2.57874	Insignificant
5 % <i>Melia azadirachta</i> seed oil + <i>Sesamum indicum</i> seed oil	326.4	32.64 ± 7.721	320.7	32.07 ± 12.19	2.57874	Significant
5% <i>Sesamum indicum</i> seed oil	-	-	316.7	31.67 ± 9.56	2.38605	Significant
5% <i>Ricinus communis</i> seed oil	-	-	310.7	31.07 ± 12.36	2.38604	Significant
Total yield	2012.7	480 kg or 12.0 maunds per acre	1824.6	432 kg or 10.8 maunds per acre	-	-

During pest attack in the experimental field of sunflower (variety-Kirani) of BCSIR Laboratory Campus Rajshahi, four different extracts from plant source viz., Bara Bishkatali leaf extract, custard apple leaf extract, Neem seed oil and a mixture of Neem seed oil and a

mixture of Neem seed oil and sesame oil were sprayed. The insect pests that attacked the sunflower plants and the inflorescence (capitulum) were collected and preserved in 80 % ethanol with a drop of glycerine. The major insect pests encountered were: *Heliothis armigera* (Hb.) (Lepidoptera: Noctuidae), *Nezara viridula* (L.) (Hemiptera: Pantatomidae), *Epilachna varivestis* Muls. (Coleoptera: Coccinellidae), *Spodoptera litura* (Lepidoptera: Noctuidae). The maximum area of flower disc attained during winter season (date of sowing: 4.11. 2002) was 426.40 sq. cm. In a large capitulum (flower), a maximum number of 830 seeds were observed weighing about 61 gm. The minimum area of a sunflower was 25 sq cm with mature seeds numbering 95 and weighing about 2.0gm when recorded. There was a mustard oilseed field adjacent to sunflower plot of BCSIR Office Gate and for this reason, pollination occurred properly in the sunflower crop field. As a result, number of immature seeds in each inflorescence was less or scanty compared to Bungalow field of sunflower in Laboratory Campus where mustard was not cultivated. The yield of sunflower was 12 maunds per acre (Table 1).

The influence of different plant extracts on the size of inflorescence and yield per sunflower plant are also shown in Table 1 in Patgram and Rajshahi centres. The analyses of variance show that the size of inflorescence and yield are highly correlated with the doses of botanicals applied. Variance ratio, F-value is significant in case of the size of sunflower (P < 0.001) The maximum yield and less pest attack were

observed in Bara Bishkatali (*Polygonum orientale*) leaf extract followed by Neem seed oil, custard apple leaf extract, a mixture of neem seed oil and sesame oil compared to control (without spraying plant extracts or botanicals). The results are presented in Table 1.

In sunflower field of Patgram, Lalmonirhat district, early (winter) crop of sunflower was sown during 1st week of November, 2003. The sunflower plants grew rapidly and these were healthy in appearance. But during flowering stage, the plants were severely attacked by fungal disease. Due to the lowest field temperature of 10 ° C, the fungal infection occurred. After infection, all the leaves of a plant turned black in colour and they appeared as burnt leaves. About 90 % of the sunflower plants under cultivation suffered from this fungal disease. As a result, the sunflower plants with their flowers (capitulum) were curled and bent horizontally. Though the flowers ripen, few viable seeds (5-10 in number) were observed in each flower. In late winter sown sunflower crop (middle of January, 2004), the fungal disease did not attack a single sunflower plant. The sunflower plants and flowers of this season attained a medium size and satisfactory yield was obtained. The reason is that the temperature during January did not favour the fungal attack. The maximum surface area of a sunflower was 250 sq cm and yield was 10.8 maunds per acre. The sunflowers under cultivation in this experimental field were mainly attacked by a red epilachna beetle, *Epilachna varivestis*. Occasionally, larvae of *Heliothis armigera* were found sucking juice from tender shoots and foliages.

The yield records of sunflower (inflorescence) in Patgram and BCSIR Centres are shown in Table 1. During the course of investigation, the banded hairy caterpillar, *Homoeosoma* sp. (Lepidoptera: Phycitidae), *S. litura* and *H. armigera* have been recorded as minor pests. The caterpillars ate the unripe seeds (achenes). According to Hill (1983), *H. electellum* (Hulst) is a minor pest of sunflower in U.S.A. that eats seeds. Another sunflower moth, *H. nebulum* Hb. is an important pest of sunflower in Europe that feeds on the seeds and causes severe losses (Horvath 1993). The major insect pests recorded in both the fields of sunflower were epilachna beetle, *Epilachna varivestis*, bollworm, *Heliothis armigera* (Hb.), stink bug, *Nezara viridula* (L.), *Monolepta signata* (Oliv.) and *Spilosoma obliqua* (Walker). Among them, *E. varivestis* was the most serious pest which attacked and sucked the inflorescence in a gregarious manner and found in plenty numbers up to 50-60 in some inflorescences and thus caused loss of the crop yield to greater extent. According to Hill (1983), *Epilachna* spp. are minor pests of sunflower in Africa which defoliated the plants.

Vasiljevic and Glusac (1994) showed that successful application of herbicides had significant effect on the development of sunflower. This finding is in agreement with the present one. It is evident that in the late sowing field of sunflower crop of Patgram, Lalmonirhat, the yield was 432 kg (10.8 maunds) compared to 480 kg (12 maunds) in the early sowing sunflower field in BCSIR Lab Campus, Rajshahi. The results are in conformity with the view of Rivera (1993) who stated that delay in

planting date has a negative effect on the seed yield and oil content of sunflower in Chile. According to Bauman *et al.* (2000), the butter obtained from sunflower oil is rich in linoleic acid that contains anti-cancer element and can be used in biomedical studies.

The role of plant extracts or botanicals in controlling the pests of stored product against *Sitophilus oryzae* has been described (Khanam *et al.* 1991). According to Butler and Henneberry (1990), pest control of vegetables and cotton can be successfully achieved by household cooking oils and liquid detergents. Plant based extracts are used for the suppression of the pests of different stored commodities and many crop pests (Stoll 1986; Ghani 1998).

Thus, it can be concluded that farmers can use water extract of the leaves of Bara Bishkatali and custard apple and Neem seed oil instead of methanol extract as botanical insecticide against the prevailing pests of sunflower under preharvest conditions.

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