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Evaluation of different oils against sorghum shoot fly infesting sorghum crop

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Abstract
Evaluation of different oils against sorghum shoot fly showed that two sprays 7 and 17 days after emergence of crop Neem Oil 1.0% recorded minimum shoot fly dead heart damage (18.25%) which was statistically at par with treatment of Karanj Oil 0.5%(19.19%), Neem Oil 0.5% (19.22%) and Karanj Oil 1.0% (19.61%). Highest yield was recorded in Neem Oil 1.0% (1241 kg/ha.) Higher cost benefit ratio was achieved in treatment of Neem Oil 0.5% and Karanj Oil 0.5% which was 1:4.22 and 1:3.07, respectively.

Keywords: Oils, sorghum shoot fly, sorghum crop

Introduction
Sorghum (*Sorghum bicolor* (L.) Moench.), commonly known as Jowar, is an important food, fodder and fuel crop and in the world ranking fifth among the major cereals after wheat (*Triticum aestivum*), rice (*Oryza sativa*), maize (*Zea maize*) and barley (*Hordeum vulgare*). Sorghum is one of the most important cereal crops of semi-arid tropics. Sorghum suitability to Iow and moderate rainfall conditions and its general ability to with stand drought makes it an ideal crop for rainfed conditions. It was hypothesized that the origin and early domestication of sorghum took place approximately 5000 years ago in North Eastern Africa.
The grain contains a very high amount of major nutrients *viz*., carbohydrate (72.6%), protein (10.4%), fat (1.9%), crude fiber (1.6%) and minerals (1.6%) with a high digestibility. In India, Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu, Gujarat, Uttar Pradesh and Haryana are the major sorghum growing states. Sorghum covering about 5.62 million hectares with 4.57 million tonnes of production under irrigated and unirrigated conditions while in Gujarat sorghum covering about 0.11 million hectares with 0.15 million tonnes of production (Anon., 2019).
Introduction of hybrid and high yielding cultivars coupled with the use of high doses of fertilizers and irrigation has resulted in an increased susceptibility to pests and diseases hence plant protection is very essential to harvest good crop. So far, over 150 insect pests have been reported on sorghum (Abdisalam, 2017) [1] among them sorghum shoot fly (*Atherigona soccata*) and stem borer (*Chilo partellus*) are important. The Sorghum Shoot fly, *A. soccata* an Antomycid fly, in the family Muscidae, order Diptera is the primary pest of economic importance of sorghum. Sukhani and Jotwani (1980) [3] reported that the losses due to shoot fly was 85.87 per cent in grain and 44.86 per cent in fodder yield. Singh *et al.*, (2017) [2] reported that Sorghum Shoot fly, *A. soccata* t is one of the most destructive pest at the seedling stage, which causes yield losses of 68.6 and 75.6 per cent in terms of fodder and grain yield, respectively. Shoot fly (*Atherigona soccata*) is a major grain yield limiting factor that causes damage when sowings are delayed in rainy season. The early-sown crop escapes from shoot fly damage but the late-sown crop in most cases is affected. Agronomic practices, natural enemies, synthetic insecticides and host plant resistance have been employed for shoot fly management to minimize the losses. Early planting is not always feasible as the sowing window is short in rainfed situations and there exists a competition with other crops for sowing.

Materials and Methods
To study the Evaluation of different oils against sorghum shoot fly, the trial was carried out under the field condition at Main Sorghum Research Station, Navsari Agricultural University, Surat (Gujarat) during Kharif-2017-18 to 2019-20.

The experiment was conducted in randomised block design with ten treatments including control and three replications. Normal tillage operation was carried out to bring the experimental plot to proper tilth and ridges. The sorghum variety GJ-42 was sown in *Kharif* season with the spacing of 45 cm X 15 cm to find out bio efficacy of different botanical oils for eco friendly management of sorghum shoot fly. 2 sprays of botanicals were done at 7 and 17 DAE of crop. 3 gram detergent /10 lit. of water were added in spray solution during each spray. Per cent shoot fly dead hearts were record at before 3 and 7 days after each spray.

Table 1: Treatment Details

T_1:- Neem Oil 0.5% (*Azadirachtaindica*)
T_2:- Neem Oil 1.0%
T_3:- Karanj Oil 0.5% (*Pongamia pinnata*)
T_4:- Karanj Oil 1.0%
T_5:- Mahuda Oil 0.5% (*Madhua latifolia*)
T_6:- Mahuda Oil 1.0%
T_7:- Castor Oil 0.5% (*Ricinus communis*)
T_8:- Castor Oil 1.0%
T_9:- NSKE 5%
T_{10}:- Control (Untreated)

Results and Discussion

Results of pooled analysis of three years showed that minimum shoot fly dead heart recorded in treatment of Neem Oil 1.0% (18.25%) which was statistically at par with treatment of Karanj Oil 0.5% (19.19%), Neem Oil 0.5% (19.22%) and Karanj Oil 1.0% (19.61%). The untreated control treatment had shown maximum shoot fly dead heart damage (34.06%). These findings are in accordance with data reported by Joshi *et al.*, (2016) [4]. Highest yield was recorded in Neem Oil 1.0% (1241 kg/ha.) Sable (2009) [5] recorded the highest yield in neem oil (2%) treated plot. Higher cost benefit ratio was achieved in treatment of Neem Oil 0.5% and Karanj Oil 0.5% which was 1:4.22 and 1:3.07, respectively. Joshi *et al.*, (2016) [4] also recorded higher cost benefit ratio in treatment of Neem Oil 2.0% and Karanj Oil 2.0%.

Table 2: Comparative efficacy of botanicals on dead heart formation by shoot fly (Pooled of 2017-18 to 2019-20)

Sr. No.	Treatment	Pooled							
		Before	1st Spray(7 DAE)		Pooled	2nd Spray(17 DAE)		Pooled	Overall pooled
			3 DAS	7 DAS		3 DAS	7 DAS		
1	T_1	20.68(13.00)	18.77(10.44)	21.91(14.00)	20.34(12.22)	29.50(24.33)	31.96(28.11)	30.73(26.22)	25.53(19.22)
2	T_2	20.61(13.06)	18.62(10.22)	21.20(13.11)	19.91(11.67)	29.01(23.56)	30.70(26.11)	29.85(24.83)	24.88(18.25)
3	T_3	19.87(12.61)	18.59(10.22)	21.67(13.78)	20.18(12.00)	29.60(24.44)	32.13(28.33)	30.87(26.39)	25.52(19.19)
4	T_4	20.96(13.89)	19.32(11.00)	22.10(14.22)	20.71(12.61)	29.94(25.00)	32.01(28.22)	30.98(26.61)	25.85(19.61)
5	T_5	22.64(16.00)	20.43(12.22)	25.93(19.22)	23.18(15.72)	34.99(33.00)	38.32(38.56	36.66(35.78)	29.92(25.75)
6	T_6	22.80(16.44)	21.08(13.00)	25.88(19.11)	23.48(16.06)	34.54(32.22)	37.61(37.33)	36.07(34.78)	29.78(25.42)
7	T_7	22.02(15.39)	20.98(12.89)	24.30(17.00)	22.64(14.94)	33.00(29.78)	36.14(34.89)	34.57(32.33)	28.60(23.64)
8	T_8	22.09(15.44)	20.86(12.78)	24.30(17.00)	22.58(14.89)	32.92(29.67)	35.99(34.67)	34.46(32.17)	28.52(23.53)
9	T_9	21.80(14.67)	19.80(11.56)	22.58(14.78)	21.19(13.17)	31.18(26.89)	33.45(30.44)	32.32(28.67)	26.75(20.92)
10	T_{10}	24.16(19.33)	22.17(14.33)	28.65(23.11)	25.41(18.72)	40.97(43.11)	48.29(55.67)	44.63(49.39)	35.02(34.06)
S.Em.		0.66	0.49	0.53	0.38	0.80	0.90	0.61	0.53
C.D.@5%		1.90	1.38	1.50	1.07	2.28	2.54	1.71	1.50
Y X T									
S.Em.		1.21	0.93	0.99	0.96	1.42	1.57	1.50	1.26
C.D.@5%		3.39	NS	NS	NS	NS	NS	NS	NS
CV%		9.62	8.07	7.24	7.62	7.59	7.64	7.63	7.80

Note:- Figures in parenthesis are original values, while those outside are arcsin transformed value

Table 3: Effect of botanicals on grain yield of sorghum

Sr. No.	Treatment	2017-18	2018-19	Pooled
1	T_1:- Neem Oil 0.5%	1152	1187	1169
2	T_2:- Neem Oil 1.0%	1221	1262	1241
3	T_3:- Karanj Oil 0.5%	1187	1173	1180
4	T_4:- Karanj Oil 1.0%	1084	1111	1097
5	T_5:- Mahuda Oil 0.5%	809	837	823
6	T_6:- Mahuda Oil 1.0%	905	926	916
7	T_7:- Castor Oil 0.5%	933	919	926
8	T_8:- Castor Oil 1.0%	988	1015	1001
9	T_9:- NSKE 5%	1043	1043	1043
10	T_{10}:- Control (Untreated)	583	556	569
SEM		27.63	18.98	15.92

CD 5%		82.10	56.38	45.37
Y X T				
SEM				23.70
CD 5%				NS
CV		4.83	3.27	4.12

Table 4: Economics of different treatments

Sr. No.	Treatment	Total Application	Cost of botanical	Labour cost	Total cost	Yield	Gross income	Net income	Profit over control	CB Ratio
1	T_1:- Neem Oil 0.5%	2	550	600	1150	1169	11694	10544	4851	1:4.22
2	T_2:- Neem Oil 1.0%	2	1100	600	1700	1241	12414	10714	5021	1:2.95
3	T_3:- Karanj Oil 0.5%	2	900	600	1500	1180	11797	10297	4604	1:3.07
4	T_4:- Karanj Oil 1.0%	2	1800	600	2400	1097	10974	8574	2881	1:1.20
5	T_5:- Mahuda Oil 0.5%	2	500	600	1100	823	8230	7130	1437	1:1.31
6	T_6:- Mahuda Oil 1.0%	2	1000	600	1600	916	9156	7556	1863	1:1.16
7	T_7:- Castor Oil 0.5%	2	725	600	1325	926	9259	7934	2241	1:1.69
8	T_8:- Castor Oil 1.0%	2	1450	600	2050	1001	10014	7964	2271	1:1.11
9	T_9:- NSKE 5%	2	3750	600	4350	1043	10425	6075	382	1:0.09
10	T_{10}:- Control (Untreated)	2	550	600	1150	569	5693	5693	0	

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