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Evaluation of Different Sesame lines (*Sesamum indicum* L.) for Enhancing the Cropping Intensity and Productivity under Foot Hill Condition of Nagaland

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ABSTRACT

Field experiment was carried out during the *kharif* season 2013 and 2014 at Agricultural Research Farm of ICAR Nagaland Centre Jharnapani to evaluate the growth and yields potential of 14 sesame lines. The main idea of the study is screening and selecting the high yielding lines of sesame, so as encourage and arouse farmer's interest in its commercial cultivation under the foot hill condition of Nagaland. The experiment was laid out in randomized block design with three replications consisting of 14 sesame lines *viz.* IAVT-14-1, IAVT-14-2, IAVT-14-3, IAVT-14-4, IAVT-14-5, IAVT-14-6, IAVT-14-7, IAVT-14-8, IAVT-14-9, IAVT-14-10, IAVT-14-11, IAVT-14-12, IAVT-14-13 and local lines as check. Result indicated that significant variations were observed in growth and yield attributes of sesame lines during the experimentation. All the sesame lines showed the better performance and produced outstanding seed yield as compared to local lines (check). However, the sesame lines IAVT-14-1 produced significantly higher seed yield (708.33 kg/ha) as compared to the other lines.

1. Introduction

Sesame or gingelly known as Til in Hindi, is one of the most ancient oilseed crops of India next to groundnut and brassica oilseeds and belongs to Pedaliaceae family. The seed has high food value because of its higher contents of good quality edible oil ranging between 48-55% and nutritious protein varies from 20-28% which is rich in methionine and tryptophan. Owing to the high quality polyunsaturated stable fatty acid, which restrains oxidative rancidity; it has earned label Queen of Oilseeds. There is an increasing interest in sesame as a source of good quality of vegetable oil, containing sesaminol and tocopherol, which are having much important antioxidants properties in the prevention of hypertension and stroke (Noguchi *et al.*, 2004), as such meets health requirement for food, an important part of diet. Besides, sesame can be processed into a number of forms for various uses such as oil, meal, paste, confectionaries and products.

Due to its high quality oil, it can be used as a substitute for olive oil; its oil can also be used in the manufacture of margarine, poorer grades for paints and soap, lubricant and illuminant as solvent or carrier for many medicines and cosmetics. Sesame, a short duration crop is considered to be basically a crop of warm regions of tropics and subtropics but its extension into more temperate zones is made possible by breeding suitable varieties. Performance of varieties often varies across environment as such it is necessary to identify the stable, promising and high yielding varieties and genotypes in the area concerned. Lacking of the suitable and good varieties or genotypes as well as agronomic practices due to insufficient information for farmers in prevailing area is one factor, which contributes to low yield in sesame. The present investigation was carried with the objective to identify the best performing, high and stable yielding sesame line under agro-climatic conditions of Nagaland.

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2. Materials and Methods

Field experiment was carried out at Agricultural Research Farm of Indian Council of Agricultural Research, Research Complex for North Eastern Hill Region, Nagaland Centre, Jharnapani, Medziphema during the *kharif* season 2013 and 2014. The experimental site was located at 25°45′ N latitude, 93°53′ E longitude with mean altitude of 295 m above the mean sea level. Experiment was laid out in randomized block design with three replications consisting of 14 sesame lines *viz*. IAVT-14-1, IAVT-14-2, IAVT-14-3, IAVT-14-4, IAVT-14-5, IAVT-14-6, IAVT-14-7, IAVT-14-8, IAVT-14-9, IAVT-14-10, IAVT-14-11, IAVT-14-12, IAVT-14-13 and local lines as a check. The soil of the experimental site was sandy loam with pH 5.3, analyzing high in organic carbon (0.58%), low in available N (175.4 kg/ha) and K_2O (138.5 kg/ha) and moderate in available P_2O_5 (18.0 kg/ha) as well as available sulphur (15.8 kg/ha). The whole experimental field was divided into 3 equal blocks and each block was again divided into 14 equal plots. The lines were randomly allotted to plot size of 4.0 ×3.0 m size maintaining a spacing of 0.5 cm between the plots. The seeds were sown @ 5 kg/ha in lines maintaining spacing of 30 cm ×10 cm.

The recommended dose of fertilizers *viz*. 60 kg N, 40 kg P_2O_5, 40 kg K_2O and 30 kg S/ha (100% RDF) was applied through urea (46% N), di-ammonium phosphate (18% N and 46% P_2O_5), muriate of potash (60% K_2O), and elemental sulphur (90% S), respectively. Sulphur was applied as per treatment two weeks before sowing the crop. Half of the entire quantity of N and full quantity of P and K was applied as basal and remaining dose of nitrogen was top dressed after one month of sowing. Weeding was done manually using hand hoe at 20 and 35 DAS.

The observations were recorded on growth characters *viz*. plant height, branches/plant, dry matter production and yield attributes *viz.* capsules/plant, seeds/capsule, length of capsule, test weight and yields at harvest stage. The experimental data pertaining to each parameter of study were subjected to statistical analysis by using the technique of analysis of variance and their significance was tested by "F" test (Gomez and Gomez 1984). Standard error of means (SEm+) and least significant difference (LSD) at 5% probability (p=0.05) were worked out for each parameter studied to evaluate the differences between treatment means.

3. Results and Discussions

Effect of weather

The weather conditions prevailing during the crop season was found to be more or less conducive. The result of the present investigation in general indicated that temperature was normal but amount of rainfall varied appreciably from normal during the crop growth period. It is a well known fact that each crop species has a definite range of temperature for different growth stages. Beyond the upper and lower threshold of temperature, metabolic activity proceeding germination is reduced. Protinase activity during germination for supplying energy to germinating and developing plant is controlled by appropriate temperature. In the present study, the meteorological data showed remarkable variation in weather condition in two years of study. Rainfall received in 2013 was quite high as compared to 2014. Further, temperature particularly at reproductive phase of crop was more conducive in second year. Therefore, resulted in slightly better performance of crops in 2014 than 2013.

Growth attributes

The data presented in Table 1 shows that the growth characters of sesame lines has significant differences during the experimentation. Among the sesame lines, taller plants (165.9 cm) were recorded with IAVT-14-8, which was significantly superior to the local check but statistical similar with IAVT-14-4 and IAVT-14-5, while the line IAVT-14-1 recorded the smaller plants (75 cm). Similarly the sesame line IAVT-14-1 attained the maximum branches, which was superior to the local check but statistical similar with the lines IAVT-14-3 and IAVT-14-13. While IAVT-14-6 recorded the lowest no. of branches, it was significantly inferior compared to other lines. This significant difference in plant height and number of branches/plant among the different lines may be attributed to the genetic constitution of the plant as well as better start and early seedling vigour, which indicates proper nutrient utilization during early growth stage of the crop or it may have been influenced by physiological parameters or growth environment. Further data showed that higher dry matter production/plant was recorded in the sesame line of IAVT-14-1, which was at par with lines IAVT-14-4, IAVT-14-6, IAVT-14-7 and IAVT-14-12 while sesame line IAVT-14-9 attained the lowest values. This may be ascribed due to more number of branches as well as leaves produced by the plant.

Table 1. Mean performance of growth and yield attributes of sesame lines (Pooled data of two years)

Variety	Plant height (cm)	Branches/ plant (No.)	Dry matter content (g/plant)	Days to 50% flowering (No.)	Days to maturity (No.)	Capsules /plant (No.)	Capsule length (cm)	Seeds/ capsule (No.)	Capsule width (cm)	Test weight (g)
IAVT-14-1	75.9	8.1	10.4	32	82	180.4	3.78	43	7.88	4.31
IAVT-14-2	120.9	6.3	6.2	32	81	155.9	3.44	36	6.85	3.52
IAVT-14-3	108.3	7.5	7.3	39	82	173.2	3.42	32	6.75	3.58
IAVT-14-4	161.4	6.8	9.7	42	82	163.1	3.63	41	7.54	3.61
IAVT-14-5	162.1	6.9	7.5	44	89	163.6	3.35	30	6.27	3.45
IAVT-14-6	117.2	2.3	9.4	34	89	63.8	3.42	32	6.75	4.04
IAVT-14-7	116.3	3.8	9.0	34	82	85.9	3.54	38	7.16	3.63
IAVT-14-8	165.9	6.1	6.5	46	87	102.2	3.54	38	7.16	3.54
IAVT-14-9	95.8	3.8	6.0	40	89	93.5	3.36	27	6.28	3.33
IAVT-14-10	99.1	5.4	7.6	40	89	113.7	3.41	29	6.48	3.58
IAVT-14-11	102.0	5.7	7.1	40	89	123.3	3.36	27	6.28	3.76
IAVT-14-12	98.6	6.8	9.0	42	87	132.9	3.54	38	7.16	3.63
IAVT-14-13	116.3	7.4	7.3	44	87	169.2	3.13	24	6.40	3.52
Local	112.9	6.0	8.4	46	104	65.8	3.13	24	6.40	3.54
SEm±	4.48	0.26	0.36	1.20	2.55	5.83	0.10	1.04	0.20	0.17
LSD (p=0.05)	13.01	0.77	1.05	3.48	7.41	16.96	0.30	3.02	0.59	NS

Table 2. Mean performance in yield parameters of sesame lines (Pooled data of two years)

Variety	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Production efficiency (kg/ha/day)
IAVT-14-1	708.33	819.44	1528	46.4	8.6
IAVT-14-2	597.22	694.44	1292	46.3	7.4
IAVT-14-3	555.56	652.78	1208	46.1	6.8
IAVT-14-4	638.89	819.44	1458	43.9	7.9
IAVT-14-5	541.67	625	1167	46.4	6.1
IAVT-14-6	555.56	638.89	1224	46.5	6.3
IAVT-14-7	611.11	750	1361	44.8	7.5
IAVT-14-8	611.11	708.33	1319	46.3	7.1
IAVT-14-9	500	555.56	1056	47.4	5.6
IAVT-14-10	527.78	638.89	1167	45.0	6.0
IAVT-14-11	500	652.78	1153	43.4	5.6
IAVT-14-12	611.11	666.67	1278	47.8	7.0
IAVT-14-13	472.22	555.56	1074	45.9	5.4
Local	472.22	611.11	1077	43.5	4.6
SEm±	29.32	39.08	54.56	1.99	0.38
LSD (p=0.05)	85.23	113.61	158.61	NS	1.11

Significant variations among the sesame genotypes in growth and yield components have also been reported by various researchers (Parameshwarappa *et al*., 2009; Adebisi *et al*., 2005; Pham *et al*., 2010; Ehsanullah *et al*., 2007 and Nahar *et al*., 2008).

Crop ontogeny

The sesame line IAVT-14-1 and IAVT-14-2 was the earliest to flowering, while the local check recorded the latest. On days to maturity, the sesame line IAVT-14-2 was the first to mature (81 days), while local (check) took the maximum days for maturity. In general, all the sesame lines attained the maturity between 81 to 89 days except for local (104 days) which were earlier than those reports made by Ogbonna and Ukaan (2012) and Morris (2009).

Yield attributes

The data from Table 1 shows significant differences were observed with respect to yield attributes among the different lines of sesame. In regard to capsules/plant, the maximum number of capsules was noted with the line of IAVT-14-1, which was statistically at par with IAVT-14-3, IAVT-14-4, IAVT-14-5 and IAVT-14-12. Similarly the sesame line IAVT-14-1 recorded the higher capsule length and seeds/capsule whereas, the lowest in local check. Capsule width IAVT-14-1 and IAVT-14-5 recorded the higher and the lower width, respectively. The variation in yield attributes of sesame might be due to genetic built-up of variety in respect of yield potential wherein the plants produced more number of branches as such more flowers, which later developed into capsules. Higher capsule length, width and seeds/capsule in IAVT-14-1 may be ascribe to greater photosynthetic activity of the plant, which resulted into greater translocation of photosynthates from leaves via stem to sink site *i.e.* capsules and seeds resulted in bigger capsule with higher number of seeds as well as bold and bigger seeds. Similar trend in capsules/plant, capsule length, capsule width, seeds/capsule and test weight was also reported by Ogbonna and Ukaan (2012) in sesame.

Crop yields and harvest index

Seed, straw and biological yield as influenced by different sesame line (Table 2). Among the sesame lines, IAVT-14-1 produced significantly the highest seed yield (708.33 kg/ha), straw yield (819.44 kg/ha) and biological yield (1528 kg/ha), which was at par with IAVT-14-4. Whereas the lowest value of seed, straw and biological yield of sesame was recorded in local, IAVT-14-13 and IAVT-14-9 lines.

Seed yield is the sum of all the yield components. Higher yield may be due to the sum total effect of enhanced growth and increased yield contributing characters like no. of seed/capsule, length of capsule, no. of capsules/plant and test weight. Similarly, the higher straw yield in IAVT-14-1 may be due to increase in growth parameters like plant height, branches/plant, dry matter production/plant and yield attributes. Higher biological yield IAVT-14-1 may be ascribe to greater seed and straw yield as it is the sum total of economic yield and straw yield. Harvest index indicates percentage of total biological yield converted to economic yield. Harvest index did not influenced by different lines of sesame. The maximum production efficiency (kg/ha/day) was observed in the line of IAVT-14-1, whereas the lowest was in local check. This might be due to greater seed yield in sesame line IAVT-14-1.Similar findings were also made by Olowe, 2007; Udom *et al*., 2006; Haruna *et al*., 2011; Ogbonna and Ukaan, 2012.

Correlation study

The data from the Table 3 represent correlation coefficient, which determined the association between the various growth and yield parameters of sesame lines. Identification of these relationships will help in the selection of suitable genotypes for high yield in sesame. The branches/plant showed positive correlation with all the parameters. Dry matter content recorded positive correlation with capsules/plant, capsule length, and width, seeds/capsule, test weight and seed yield. Capsule length showed positive correlation with seeds/capsule, capsule width, test weight, seed yield. Seeds/capsule was found to be positively correlated with capsule width, test weight, seed yield. Capsule width showed positive correlation with test weight, seed yield. Test weight showed positive correlation with parameters like seed yield. The positive relationship observed between no. of capsule/plant, no. seeds/capsule, capsule length and 1000-seed weight is in sesame line with earlier findings of Pham *et al*., (2010); Adebisi *et al*., (2005); Bhattacharya *et al*., (2010); Islam (2010); and Ogbonna and Ukaan (2012).

Possible impact

Sesame is an energy (oil ranging between 48-55% and nutritious protein varies from 20-28%) rich crop and can be cultivated in vast areas of rice fallow land during the *kharif* season under delayed onset of monsoon. Such practice would not only provide nutrition and increase income of the farming community but would also increase the cropping intensity, employment, land use efficiency.

Table 3. Correlation coefficient between the yield attributes and yields of sesame lines

Parameters	Branches/ plant (No.)	Dry matter content (g/plant)	Capsule /plant (No.)	Capsule length (cm)	Seeds/ capsule (No.)	Capsule width (cm)	Test weight (g)	Seed yield (kg/ha)
Branches/ plant (No.)	1.000							
Dry matter content (g/plant)	0.520	1.000						
Capsule /plant (No.)	0.834**	0.310	1.000					
Capsule length (cm)	0.128	0.499	0.274	1.000				
Seeds/ capsule (No.)	0.195	0.512	0.291	0.943**	1.000			
Capsule width (cm)	0.277	0.656*	0.285	0.875**	0.938**	1.000		
Test weight (g)	0.250	0.715**	0.810	0.540*	0.448	0.570*	1.000	
Seed yield (kg/ha)	0.249	0.549*	0.343	0.952**	0.986**	.945**	0.541*	1.000

Inclusion of oilseed crop in rice based system would also make rice cultivation more sustainable and enhance profitability of the tribal farmers in the region. Realizing this potential, large-scale demonstration on sesame cultivation technologies are being undertaken by KVK, State Agriculture Department and NGO etc.

Conclusion

From the above study, it can be concluded that there is enough scope for cultivation of sesame in upland area of rice fellow under delayed onset of monsoon. Therefore, the sesame lines IAVT-14-1 and IAVT-14-4, which showed outstanding performances in terms of growth and yield, are therefore recommended for commercial cultivation in derived agro-ecology of foot hill condition of Nagaland.

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