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Increased Productivity of Sesame through Improved Production Technologies in Bundelkhand

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ABSTRACT

Sesame (Sesamum indicum L.) is most important oil seed crop in Bundelkhand region. One of the major problem of its low productivity is non-adoption of improved technologies. Front line demonstration were conducted at 50 farmers field, to demonstrate production potential and economic benefit of improved technologies comprising short duration, phillody (mycoplasma) resistant varieties, line sowing, integrated nutrient management and timely weed removal (TKG-55, TKG-22 and Pragati), line sowing (45×10 cm), integrated nutrient management (55:25:15:35, NPKS kg/ha). The seeds were treated with phosphate-solubilzing bacteria each at 20 g/kg of seeds. Pre-emergence application of weedicide Pendimethalin at 1 kg a.i /ha used for effective control of the weeds during Kharif season of 2016 to 2017 in rainfed condition. The improved technology recorded a mean yield of 6.7 q/ha which was 24.5% higher than that obtained with farmers practice yield of 3.99 q/ha. The improved technologies resulted higher mean net income of Rs.17810/ha with a benefit cost ratio of 2.75 as compared to local practice (10742/ha, 2.52).

Key words: Sesame, frontline demonstration, improved technologies, productivity.

INTRODUCTION

Sesame (*Sesamum indicum*) commonly known as til which is an ancient oilseed crop grown in India, and perhaps the oldest oilseed crop in the world. The crop is now grown in a wide range of environments, extending from semiarid tropics and subtropics to temperate regions. Consequently, the crop has a large diversity in cultivars and cultural systems. India is the largest producer of sesame in the world. It also ranks first in the world in terms of sesame-growing area (24%). It is reported that the increase in sesame productivity is about 2% for Ethiopia and India and 2.8% for China in the period of 1990 to $2007 (FAO)^3$. Perhaps the productivity increase should better be interpreted as a linear trend with and increase of 7 kg/ha per year in India, 13 kg/ha per year in Ethiopia and 22 kg/ha per year in China. Clearly, the level and rate of increase of yield per hectare of sesame in China is more than 50% higher than in Ethiopia. This probably indicates a great opportunity for a prolonged and higher increase in sesame productivity in India. In order to realise this opportunity, an analysis is needed of the major constraints limiting sesame current productivity in India.

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The yield increase is due both to development and use of improved varieties and improved agronomy practices and crop protection ¹⁵. The potential yield of sesame still is much higher than actual yield, as still much damage occurs by pests and diseases, insufficient weed control, to high levels of monocropping, lack of mechanization (amongst others causing seed shattering when not enough labour is available during harvest) and unrealised genetic potential. Potential yields are probably as high as 2000 kg/ha¹⁰. Its seeds may be eaten fried, mixed with sugar or in the form of sweat meats. Sesame oil is used as a cooking oil in southern India. It is also used for the body, anointing for manufacturing perfumed oils and for medicinal purposes. Sesame cake is a rich source of protein, carbohydrates and minerals, such as calcium and phosphorus. The cake is edible and is eaten widely by working classes. It is also a valuable and nutritious feed for milch cattle. The oil is highly resistant to oxidative rancidity and exerts synergistic affect on the action of certain insecticides like pyrethrins and rotenone. It is reported that sesame oil contains sesamolin and sesamine which is used as synergist for insecticides. Sesame is grown in an area of 7.54 million hectares with a production of 3.34 million tonnes in the world with a productivity of 443 kg/ha⁴. China, Myanmar and Sudan account for 40% of the world's sesame production. In India, sesame is grown in about 1.8 million hectares with a total production of 0.76 million tonnes and productivity of 422 kg/ha⁴. West Bengal alone accounts for 25% of the total sesame production in India. The other major sesameproducing states are Gujrat, Madhya Pradesh, Tamil Nadu, Maharashtra, Karnataka, Rajasthan and Uttar Pradesh. The effect of plant population on vield and vield components have been reported by several workers. For example, seed yield per unit area increases with increases population density from 80,000 to 160,000 plant/ha and beyond this density in becomes counterproductive². Also increased number of seed per capsule, number of capsule per plant, and dry matter

production increased when the intra-row spacing increased from 30 to 90 cm^{11} . In general, average productivity of sesame continues to be lower (144 to 234 kg/ha) than expected from agricultural technology for the last 20 years, mainly due to its cultivation on marginal lands, under poor management and without inputs except seed. The major constraint responsible for lower yield are inappropriate production technologies viz; broadcast method of sowing, no use of fertilizer and untimely weed management (45 $DAS)^{7}$. The yield of sesame can be increased by 21 to 53% with adoption of improved technologies such as improved variety, recommended dose of fertilizer, weed management and plant protection. Keeping this in view, frontline demonstrations on sesame were conducted to demonstrate the production potential and economic benefits of latest improved technologies on farmer's fields.

MATERIALS AND METHODS

Front line demonstrations were conducted on 50 farmers fields of different villages viz; Bhojla, Bilati Karke and Dangrwaha (District Jhansi), Bhaloni Suwa (District Lalitpur) and Kurehna and Akberpur Etaura (District Jalaun) in Bundelkhand region of Uttar Pradesh during Kharif seasons of 2016 and 2017 in rainfed condition, on light to medium soil with low to medium fertility status under sesamegram production system. Each demonstration was conducted on an area of 0.2 ha and the same area adjacent to the demonstration plot was kept as farmers practices. For many of the diseases and pests resistance occurs in sesame, e.g. resistance to phyllody¹², resistance to powdery mildew and phyllody in India⁵. The package of improved technologies included phillody (mycoplasma) resistant varieties, line sowing, integrated nutrient management and timely weed removal. The varieties of sesame TKG-55, TKG22 and Pragati in 2016 to 2017 were included in demonstrations. The spacing was 45 cm between rows and 10 cm between plants in the row. Thinning was done scrupulously to ensure recommended plant

spacing within a row. The first thinning was done invariably 16 days after sowing and the second thinning 23 days after sowing. Excess population adversely affects growth and yield of crop. Seed was treated with Thiram at 2.5 g/kg seed for prevention of seed-borne diseases. Seed sowing was done between July 25 to August 2 in 2016 and 2017 with a seed rate of 4.5 kg/ha. Entire dose of N and P through diammonium phosphate and K through muriate of potash and sulphur at 55:25:15:35, respectively, was applied as basal before sowing. In India, highest net returns were found with 60 kg N/ha, 30 kg P/ha and 15 kg K/ha¹⁴. 40 kg S/ha productivity increased from 700 to 800 kg/ha with also a 3% higher oil content (increase from approx. 47 to $50\%)^{10}$. Hand weeding was done once at 25 days after sowing. Weeds were also controlled effectively by using of proper herbicides. In 2016 the weedicide was used Diuron at 400-600 g/ha, and in 2017 Pendimethalin was used at 1 kg a.i/ha as preemergence treatment for effective control of weed. The crop was harvested during September 25 to October 10 after the leaves turn yellow and start dropping while the capsules are still greenish- yellow.

RESULTS AND DISCUSSON

A total rainfall of 623 and 556 mm was recorded in 45 and 40 rainy days during the crop season of 2016 and 2017, respectively however, heavy rainfall (779 mm) was received in the mid of July. This caused an unusual delay in sowing during 2016 and lowered productivity of sesame. The late planted crop finds relatively less time for plant growth and development. The sesame crop received 213.8 mm rains in 2017 at maturity stage during first week of October. This caused seed sprouting and shattering in the capsule itself in standing crop conditions which lowered the productivity.

The yield attributing characters of number of capsule per plant under improved technology were 135.60 and 115.20 as against local check (farmers practice), 100.2 and 85.6, (Table 1) during the year 2016 and 2017, respectively. There were 26.10 and 25.69 % increase in number of capsules under demonstration of improved technology over and above local check (farmers practice). The average number of capsules per plants were 125.4 under improved technology and 92.9 under local check, thus there were 25.89% more capsules per plant under improved technology demonstration as compared to local check. The average number of seeds per capsules observed in improved technology was 74.55 as compared to 69.8 in local check. The percentage increase in seeds per capsules during years 2016 -2017 were 8.48 and 4.13, respectively with and overall average 6.30 seeds per capsules. As regards test weight (g/1000 seed) the observation showed that during the years 2016 and 2017 the test weight under improved technology and local check were 3.00 and 1.80, respectively with an average test weight 2.56 under improved technology and 1.59 under local check. The per cent increase in test weight during above year was found to be 40.00, and 34.91 with average of 37.45.

The productivity of sesame in District Jhansi, Lalitpur and Jalaun of Uttar Pradesh in India under improved production technology ranged between 684 and 656 kg/ha with mean yield of 670 kg/ha. The productivity under improved technology varied from 684 to 523 and 656 to 491 kg/ha with a mean yield of 670 and 507 kg/ha during 2016 and 2017 respectively (Table 2) as against a yield range between 440 and 358 kg/ha with a mean of 399 kg/ha under farmer's practices (local check). The additional yield under improved technologies over farmers practice ranged from 173 to 162 kg/ha with a mean of 167 kg/ha. In comparison to farmer's practice, there was an increase of 28.00, 21.00 and 24.5% in productivity of sesame under improved technologies in 2016 and 2017. Respectively the increased grain yield with improved technologies was mainly because of line sowing, use of nutrient management and timely weed management.

Fertilizer response has been widely studied in other countries and the extent of the

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response depends on many factors: with high vielding varieties higher fertilizer rates are needed and also in cases of lower soil fertility¹⁴. Sometimes micronutrients and improvement of cation exchange capacity proved helpful, for example by use of humix (humic acid preparation) Abo-El-Wafa and Abd-El-Lattief¹ reported that integrated nutrient management increased productivity by 36% as compared to local variety of sesame. Kinman and Stark⁹ reported that adoption of improved variety increased productivity by 32% as compared to local variety of sesame. Improved technology produced higher grain vield in 2016 and 2017as compared to local check. The reason for this could be the inter plant competition for the moisture and nutrients which could be more severe under local check demonstration (Farmers practice). Also, the higher weed infestation under the local check as evident from the higher weed cover and reduced the amount of nutrients and water available to the local check. This agrees with the findings of Imoloame et al.⁶ and Stonebridge¹³ who reported the superiority of row planting over broad casting to control weed and that this factor resulted in considerable yield increased and also grain yield increased significantly.

Phytopthora and Phyllody resistant variety, integrated. The economic viability of

technologies improved over traditional farmer's practices was calculated depending on prevailing prices of inputs and output costs (Table 3). It was found that cost of production of sesame under improved technologies varied from Rs 6920 to 8500 /ha with an average of Rs. 9060/ha as against Rs. 8225 to 6500 /ha with an average of Rs.7362.5/ha under farmers (local The practice check). improved technologies registered production an additional cost of production ranging from Rs. 1395 to 2000/ha with an average of Rs. 1697.5/ha over local check. The additional cost increased in the improved technologies was mainly due to more cost involved in balanced fertilizer, improved seed and weed management practices. Cultivation of sesame under improved technologies gave higher net return which ranged from Rs 14366 to 21254/ha, with a mean of Rs. 17810/ha as compared to farmers practices which recorded Rs. 7872 to 13612/ha with mean of Rs. 10742/ha. Similar results also have been reported by Khan *et al.*⁸. There was an additional net return of 6494 in 2016 and 7642 in 2017 under demonstration plots. The improved technologies also gave higher benefit cost ratio, 2.00, 3.50 and 2.75 compared to 1.96, 3.09, and 2.52 under local check in the corresponding season.

Yield attributing characters											
Year	Rainfall during crop season (mm)	Rainy days during crop season (no.)	No. of capsules/plant			No. of seeds/Capsule			Test weight (gm)		
			Improved technology	Local check	% increased	Improved technology	Local check	% increased	Improved technology	Local check	% increased
2016	623	45	135.60	100.20	26.10	76.60	70.10	8.48	3.00	1.80	40.00
2017	556	40	115.20	85.60	25.69	72.50	69.50	4.13	2.12	1.38	34.91
Average	589.5	42.5	125.4	92.9	25.89	74.55	69.8	6.30	2.56	1.59	37.45

Table 1: Yield attributing characters of Sesame

				Yield (q/ha)					
Year	Area (ha)	Demonstration (No.)	Improved technology			Local	Additional yield	% increased in	
			Maximum	Minimum	Average	check	check	check	
2016	5.0	25	6.84	5.23	6.13	4.40	1.73	28.00	
2017	5.0	25	6.56	4.91	5.20	3.58	1.62	21.00	
Averag e	5	25	6.7	5.07	5.66	3.99	1.67	24.5	

Table 2: Seed yield of Sesame as affected by improved and local practices in farmers fields

Table 3: Cost of cultivation (Rs/ha), net return (Rs/ha) and benefit: cost-ratio of Sesame as affected by improved and local practices

	Total cast of o	cultivation	Net return	(Rs/ha)	B:C ra	ıtio		
Year	Improved Local technology check		Improved Local technology check		Improved technology	Local check	Additional cost of cultivation (Rs/ha)	Additional net return (Rs/ha)
2016	9620	8225	14366	7872	2.00	1.96	1395	6494
2017	8500	6500	21254	13612	3.50	3.09	2000	7642
Average	9060	7362.5	17810	10742	2.75	2.52	1697.5	7068

CONCLUSION

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The results from the current study clearly brought out the potential of improved production technologies in rainfed condition of Uttar Pradesh in India. To get maximum yield of sesame recommended package of practices should be followed. By not following any one management practice yield may be reduced severely and it was also observed that delay in sowing, unbalanced does of fertilizer, untimely weed management and plant protection drastically reduced the grain yield of sesame.

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