PLANT DENSITY EFFECT ON THE GROWTH AND YIELD OF SESAME-A REVIEW

P. Kalaiselvan, K. Subrahmaniyan and T.N. Balasubramanian
Regional Research Station
Tamil Nadu Agricultural University, Vridhachalam-606 001, India

ABSTRACT

Plant population is most critical for obtaining higher yield in sesame. Above or below the threshold level of plant population it would lead to intra species competition among plants for scarce resources which cause sub normal sesame seed yield. Hence, identification of optimum population for each variety being tested become vital. Various reports indicate that the growth and yield attributes and yield of sesame were determined by plant densities. Adoption of suitable and optimum spacing would fulfill the objective of maximizing the yield of sesame.

Sesame (Sesamum indicum L.) is widely grown in topical and sub topical regions of the world such as India, Burma, China and Japan and also in the hotter and drier parts of Africa and Mediterranean region. Sesame is an ancient oilseed crop of India is grown on 1.67 m. ha contributing 0.6 m.t to the country total oilseed production. India’s share to the total world’s sesame production is 27%. Besides being used for various purposes in our country, it has also export potential. During 1997-98 the country has earned about Rs.272 crores through export of 1.2 lakh tonnes of sesame seed. But the production is far lesser compared to other countries with mean productivity of 250 kg ha⁻¹ (Anon., 1999-'00). The share of sesame in total oilseeds area has more or less remained stagnant at 9.2%, its production has registered an increase of almost 70% during the last decade. However the production level is still far less than the actual potential of the crop (Anon., 1996-'97). Therefore, there is an immediate need for augmenting sesame production in our country. Of the several factors attributed for seed yield in sesame, plant population plays a vital role. In order to increase the productivity of sesame through maintaining plant population, the earlier literature on these lines have to be understood properly.

Plant spacing plays a major role in influencing the yield of sesame varieties having more number of branches (Gnanamoorthy et al., 1992). Optimum plant population is important for branching insertion, capsule production and higher yield (Balasubramaniyan et al., 1995). The maximum yield potential of sesame can be exploited by agronomic manipulations in a given set of climatic conditions. Plant density is one of the important aspects of yield exploitation which may reduce undesirable influence of climate to a considerable extent (Chimanshette and Dhoble, 1992). Poor growth and inadequate plant stand have been the important factors responsible for poor yield (Majumdar & Roy 1992).

Influence of plant population on growth parameters: Plant density greatly affect the growth parameter of sesame viz., plant height, number of branches, dry matter production and harvest index. Quayyum et al. (1990) reported that intra row spacing exerted highly significant effect on days to 50 per cent flowering whereas inter row spacing had not shown significant effect on flowering. Kandasamy et al. (1991) observed significant difference in plant height at a spacing of 22.5 cmx22.5 cm. Gnanamoorthy et al. (1992) observed that number of branches was significantly more with the spacing of 30 cmx15 cm and 30cmx20 cm when compared to 30 cmx10 cm, 30cm x25 cm and 30cmx30 cm.
Majumdar and Roy (1992) reported that increase in row spacing significantly increased the dry matter accumulation per meter square. Similarly Ghosh and Patra (1994) observed that the highest harvest index was with high plant density. Balasubramaniyan et al. (1995) reported that significantly more branches per plant was produced under a plant population of 1,50,000 plants ha$^{-1}$ as compared to 3,00,000 plants ha$^{-1}$ and 4,44,000 plants ha$^{-1}$. Ramanathan and Chandrasekaran (1998) observed that 45 cm x 15 cm enhanced the plant growth characters viz., plant height and branches per plant when compared to 45 cm x 30 cm.

Influence of plant population on yield components and seed yield

Plant density: One of the methods of cultural manipulation in sesame was to alter the population density in order to produce yield variations (Menon, 1967). On the other hand, Nadi and Lazin (1974) reported that increase in population density had increased seed yield, which was positively correlated with number of capsules plant$^{-1}$, number of seeds capsule$^{-1}$ and 1000 seed weight.

Kamel et al. (1983) reported that 5,00,000 plants ha$^{-1}$ was an optimum plant density for sesame, whereas Rao et al. (1985) reported that 30 cm row spacing and 15 cm plant spacing were significantly superior to other treatments. Narayan and Narayanan (1987) reported that harvest index, shelling percentage, number of seeds capsule$^{-1}$ and test weight showed no significant difference due to increase in population density. But the yield contribution and the number of capsules by the main stem increased with population density whereas that of branches decreased because of the decrease in number of branches with increase in population density. They also found that the total grain yield of sesame linearly increased from 16 to 66 plants per square metre. Jahnvi Shekar (1988) reported that 20 cm row spacing proved to be best (554.8 kg ha$^{-1}$) compared to 40 cm which gave significantly the lowest grain yield (483.4 kg ha$^{-1}$). But Patel et al. (1988) reported that 30 cm row spacing and 15 cm plant spacing were significantly superior to other treatments. Similarly higher yield at a spacing of 30 cm x 10 cm (356 kg ha$^{-1}$) than at 30 cm x 15 cm (276 kg ha$^{-1}$) or 20 cm x 10 cm (280 kg ha$^{-1}$) were reported by Bikram Singh et al. (1988). Arunachalam (1989) confirmed that 2 lakh plants ha$^{-1}$ (30 cm x 15 cm) recorded higher yield than other levels in Tamil Nadu.

Mandal et al. (1990) studied three plant density levels (1,10,000, 1,66,000, 2,22,000 ha$^{-1}$) and found that the highest seed yield of 1084 kg ha$^{-1}$ was obtained from 2,22,000 plants ha$^{-1}$ as compared to other plant densities. However, yield parameters like number of branches plant$^{-1}$, number of capsules plant$^{-1}$, seeds capsule$^{-1}$ and 1000 seed weight were higher under 110,000 plants ha$^{-1}$. But Quayyam et al. (1990) found that capsules plant$^{-1}$ and grain yield were more at wider plant and row spacing of 20 cm x 30 cm.

Kandasamy et al. (1991) studied the effect of different spacing viz: 22.5 x 22.5, 30 x 30, 30 x 15, 45 x 15 cm and found that 22.5 x 22.5 cm (1,97,530 plants ha$^{-1}$) produced higher number of capsules plant$^{-1}$ and the lowest one was with 30 x 30 cm spacing. Chimansthette and Dhoble (1992) reported that the plants under higher plant population of 2,22,222 plants ha$^{-1}$ (30 x 15 cm) did grow short as a result of geometry effects. They also found that the seed yield decreased significantly with the decrease in plant density from 2,22,000 to 1,11,000 plants ha$^{-1}$.

Avila et al. (1992) studied branched and unbranched sesame cultivars with different row spacing of 50, 60 and 70 cm and reported that the seed yield and number of plants per metre square were the only parameters
significantly increased by reducing the spacing. Further, they observed that the spacing effect was mostly pronounced in the unbranched compared to branched cultivars.

Ghunarde et al. (1992) studied two varieties with different row spacing of 30, 45 and 60 cm and plant spacing 10, 15 and 20 cm. They reported that narrow row spacing of 30 cm was significantly superior to 45 and 60 cm in registering higher seed yield ha\(^{-1}\). Whereas plant spacing of 15 cm was significantly superior to 10 and 20 cm. They also found that under wider spacing though the number of branches and capsules plant\(^{-1}\) were maximum, it could not compensate the yield loss because of less population and vice versa under narrow row spacing.

Ghunarde et al. (1992) observed higher seed yield due to closer spacing (30 x 15 cm). However, wider spacing generally gave more branches and capsules plant\(^{-1}\). Sarma and Kakati (1993) studied different sesame cv. C 7, TC 25 and Vinayak with 30 x 15, 35 x 15, 40 x 15 cm spacing and reported that seed yield was altered by spacing. Similarly, Sarma (1994) studied different spacing of 30 x 15, 35 x 15 and 40 x 15 cm and found that spacing had no significant effect on seed yield or yield components. But Ghosh and Patra (1994) reported that seed and stalk yields of sesame decreased sharply due to reduction in plant density. High plant density (3,33,00 ha\(^{-1}\)) recorded the highest seed and stalk yields and were significantly superior to those of low and medium plant densities.

At Vriddhachalam, though yield increase was noticed for higher plant population, it was not significant during 1992-93. But in 1994 study, significant increase in yield was recorded due to adoption of higher plant population of 4.5 lakh ha\(^{-1}\) (791 kg ha\(^{-1}\)) as compared to lower plant population of 1.5 lakh plants ha\(^{-1}\) (753 kg ha\(^{-1}\)) and at par with 3.0 lakh plants ha\(^{-1}\) (778 kg ha\(^{-1}\)). At Tikamgrah, higher plant population of 3.33 lakh plants ha\(^{-1}\) (30 x 10 cm) gave significantly higher yield of 554 kg ha\(^{-1}\) as compared to lower plant population of 2.22 lakh plants ha\(^{-1}\) (30 x 15 cm) (486 kg ha\(^{-1}\)). Similarly, at Nagpur higher plant population of 3.33 lakh plants ha\(^{-1}\) gave significantly higher yield of 422 kg ha\(^{-1}\) as compared to lower plant population of 2.22 lakh plants ha\(^{-1}\) (366 kg ha\(^{-1}\)). But at Mandore it was found that 15 cm between plants gave significantly higher mean seed yield of 428 kg ha\(^{-1}\) as compared to 8 cm (331 kg ha\(^{-1}\)) and at par with 10 cm spacing (404 kg ha\(^{-1}\)) (Anon, 1995-96). Ramanathan and Chandrasekaran (1998) observed that the plant geometry of 45x15 cm gave the highest seed yield and was significantly superior to other two levels viz., 30x30 cm and 45x30 cm. Subrahmaniyan and Arulmozhi (1999) reported that a favourable increase in yield parameters was observed with a plant population of 1,11,000 plants ha\(^{-1}\). However the plant population of 1,66,000 plants ha\(^{-1}\) recorded significantly higher seed yield.

Genotypes and plant density: No significant difference in yield due to different row spacing in cv. Punjab and Til No. 1 was observed by Jahnvi Shekhar (1988). Tomar et al. (1992) conducted an experiment with sesame cultivars viz., NP 6, TMV 3 and selection R during rainy season of 1989 with 30 x 30, 30 x 20 and 30 x 10 cm spacing and had recorded mean seed yields of 710, 930 and 740 kg ha\(^{-1}\) at these three spacing respectively. However, the seed numbers capsule\(^{-1}\) and 1000 seed weight were not significantly affected by spacing. They concluded that 30 x 10 cm (3 lakh plants ha\(^{-1}\)) gave the best economical return compared to other levels.

Majumdar and Roy (1992) studied different spacing for sesame cv. B 67 during summer seasons of 1988 and 1989 in West Bengal and found that the highest seed yield
of 1.62 t ha\(^{-1}\) was obtained from 30 cm row spacing and at a density of 3,33,000 plants ha\(^{-1}\) in sandy loam soil in both the seasons. They further observed that increase in row spacing significantly increased the primary branches plant\(^{-1}\), capsules plant\(^{-1}\), seeds capsule\(^{-1}\), seed and stalk yields. However, row spacing and population had no significant influence on 1000 seed weight.

In a field trial at Parbhani, sesame cv. Punjab No. 1 and JLT 7 were compared in rows of 30,45 and 60 cm apart with 10,15 and 20 cm between plants. Seed yield decreased with increase in row spacing and was highest with 15 cm within row spacing and concluded that 30 x 15 cm was an optimum spacing for sesame (Jadav et al., 1992). Similarly, Gnanamurthy et al. (1992) reported that 30 x 20 cm (1,67,000 plants ha\(^{-1}\) was an optimum spacing for TMV 3 as compared to 30 x 30 cm for Kharif season. Channabasavanna and Setty (1992) studied different population densities viz., 2,22,222 (30 x 15 cm), 3,33,333 (30 x 10 cm) and 6,66,666 (30 x 5 cm) plants ha\(^{-1}\) at Andhra Pradesh with two sesame entries viz., cv G 8 and DS 1. They found that 6,66,666 plants ha\(^{-1}\) gave higher seed yield of 758 kg ha\(^{-1}\) for the two entries studied compared to lower population level of 3,33,333 (727 kg ha\(^{-1}\) and 2,22,222 plants ha\(^{-1}\) (655 kg ha\(^{-1}\)). The capsules per square metre also followed similar trend.

The results of the On-Farm Research conducted with TMV 3 involving different population density viz., 11, 19 and 20 plants per metre square showed that 11 plants per metre square recorded higher yield than the other two levels (Palaniappan et al., 1993).

Influence of plant population on oil content: Mazzani and Cobo (1956) found little variation in oil percentage among different plant densities. Tomar et al. (1992) reported that oil content was not significantly affected by spacing. Oil content did not vary much due to variation in plant density but oil yield decreased markedly due to decrease in plant density (Ghosh and Patra., 1994).

**REFERENCES**


