

Effect of plant geometry and age of the seedlings on growth and yield attributes of mustard (*Brassica juncea* L.) under system of mustard intensification (SMI)

ABSTRACT

The field experiment entitled “Effect of plant geometry and age of the seedlings on growth and yield of mustard (*Brassica juncea* L.) under System of Mustard Intensification (SMI)” was conducted at College Farm, Agricultural College, Polasa, Jagtial in *Rabi*, 2022. The experiment was laid out in randomized block design with eleven treatment combinations by replicating thrice. The treatment includes T₁: Conventional sowing (dibbling) with spacing 45 x 15 cm without gap filling, T₂: Conventional sowing (dibbling) with spacing 45 x 15 cm with gap filling, T₃: 15 days old seedlings with spacing 30x30 cm, T₄: 15 days old seedlings with spacing 45x45 cm, T₅: 15 days old seedlings with spacing 60x60 cm, T₆: 20 days old seedlings with spacing 30x30 cm, T₇: 20 days old seedlings with spacing 45x45 cm, T₈: 20 days old seedlings with spacing 60x60 cm, T₉: 25 days old seedlings with spacing 30x30 cm, T₁₀: 25 days old seedlings with spacing 45x45 cm, T₁₁: 25 days old seedlings with spacing 60x60 cm. Thus from results obtained from present investigation it can be concluded that transplanting 25 days old seedling with 30 x 30 cm spacing under System of Mustard Intensification (SMI) resulted in higher plant height (182.5) and dry matter production (4660) due to more plant population and vigorous growth of seedlings while Transplanting 25 days old seedling with 60x60 cm resulted in higher no. of primary and secondary branches plant⁻¹(9.0 and 24.6), no. of siliqua plant⁻¹ (656.3) and no. of seeds siliquae⁻¹(14.7) due to wider spacing more efficient utilization of resources per plant.

Key words: mustard, plant geometry, age of the seedlings, transplanting, system of mustard intensification.

INTRODUCTION

Oilseed Brassica share 27.8% of India's oilseed economy and account for 35% of all oilseed output, with an average productivity of 1524 kg ha⁻¹ (Indiastat, 2021). It is grown on 6.7 million hectares of land in India, where it produces an average of 10.21 million tonnes with a productivity of 1524 kg ha⁻¹ (Indiastat, 2021). Rajasthan is the leading producer of mustard followed by Uttar Pradesh. In Telangana, mustard is grown over an area of 2000 hectares with a production of 1.84 million tonnes and productivity of 922 kg ha⁻¹ (Indiastat, 2022). Mustard mostly farmed as a *rabi* crop in the Northern Telangana Zone districts of Jagtial, Nizamabad, Nirmal and Kamareddy (Department of Agriculture, 2021).

Planting geometry i.e., row to row and plant to plant distance plays a vital role in the production of rapeseed and mustard under irrigated condition. Spacing is a non-monetary input, but it plays a vital role by changing the magnitude of competition. The competitive ability of a mustard plant depends greatly upon the density of plants per unit area and soil fertility status (Shekhawat *et al.*, 2012). Uniform distribution of crop plants over an area result in efficient use of space, nutrients, moisture and suppression of weeds leading to high yield.

Transplanting the crop rather than normal drilling may be a costlier method of crop establishment, however, the labour requirement for sowing and then thinning the crop twice, to remove extra plants, may be costlier. Transplanted crop has the exact plant population with mathematical precision and there is also some time benefit after harvest of the kharif

crops. Through transplanting, the full potentiality of individual plants can be realized and yield more than drilling of seeds. The late sowing of mustard cultivars resulted in yield losses and thus affected the supply chain of the oil in the market. The forceful late sowing conditions of the crop are mainly because of delayed harvesting of kharif crops. Therefore, early crop establishment through transplanting technique could be a better alternative option to minimize the yield losses in mustard.

MATERIALS AND METHODS

The experiment was carried out at the College Farm, Agricultural College, Polasa, Jagtial, Professor Jayashankar Telangana State Agricultural University. The experimental site was located between 18° 50' 58" N latitude and 78° 56' 97" E longitude at an altitude of 243.4 meters above mean sea level (MSL) (Plate 1.). It is assigned to the Northern Telangana Zone of Telangana. The soil was sandy clay loam, low in nitrogen (179.2), phosphorous (13.8) and high in potassium (310) with pH (7.53).

The seedlings were raised on a nursery bed of size 3m × 1m × 15 cm. the soil was made friable and mixed well with 15 kg vermicompost, 5 kg farmyard manure, 2 kg red soil and 2 kg sand. The seeds were treated with captan @ 4g/kg of seed. After sowing was done nursery bed is covered with straw for mulching purpose. Frequent irrigation was given after the emergence of the seedlings based on the visual symptoms. On 12th November 2022, the 15, 20 and 25 days aged seedlings were transplanted as one seedling per one hill at a spacing of 30 × 30 cm, 45 × 45 cm and 60 × 60 cm in the respective plots (as per the treatment details). The seeds were manually planted using the dibbling method @ 3- 4 seeds hill⁻¹ at a spacing of 45 cm between the rows and 15 cm between the plants for the optimal plant stand development. To retain optimum plant stand gap filling was taken up in the field at 10 DAS. Thinning of excess seedlings to maintain 1-2 seedlings per hill was done at 25 DAS regarding conventional sown treatments. A recommended dose of fertilizer for mustard was Nitrogen @ 60 kg ha⁻¹, Phosphorous @ 40 kg ha⁻¹ and Potassium @ 40 kg ha⁻¹. The N, P and K fertilizers were applied as urea (46% N), single super phosphate (16% P₂O₅) and muriate of potash (60% K₂O), respectively. Crop growth parameters recorded were Plant height (cm), no. of primary and secondary branches plant⁻¹ and dry matter accumulation. Yield attributes recorded were no. of siliqua plant⁻¹ and no. of seeds siliquae⁻¹.

RESULTS AND DISCUSSION

Plant height

Plant height is an imperative morphological growth parameter. It exhibits the vigour of the plant. It has a significant role in capture of light and sun-oriented radiation. Plant height increased with advance in duration of mustard crop. Critical observation of data revealed that the plant height of mustard crop varied significantly at branching initiation stage, flowering stage, siliqua development stage and at maturity stage. Among the treatments, the 25 days old seedlings with spacing 30×30 cm (T₉) resulted in significantly highest plant height (44.7 cm, 146.7 cm, 177.6 cm and 193.2 cm) at branching initiation, flowering, siliqua development and at maturity stage respectively which was on par with T₆ and T₃ treatments. Lowest plant height recorded in T₁ i.e. conventional sowing (dibbling) with spacing 45 x 15 cm without gap filling (29.0, 98.6, 112.8 and 145.7) at branching initiation stage, flowering stage, siliqua development stage and at maturity stage respectively.

The enhanced plant height in mustard under 30 cm × 30 cm spacing over other plant geometry might be due to competition for light at closer spacing as compared to wider spacing under transplanting. Similar results were also reported by Kumar *et al.* (2004), Singh *et al.* (2006) and Singh *et al.* (2019b). The significantly higher plant height under transplanting of 25 days old seedlings may be owing to the fact that optimum age of

seedlings performed active growth which might have contributed to more vigorous growth and development. Transferring plants that are too young will slow down their growth, because the seedlings have not been able to cope with unfavourable environmental conditions in the field. Similar results were also reported by Aragie *et al.* (2023).

Dry matter accumulation

Dry matter is the accretion of photosynthates after respiration and anabolic process. The results illustrated that there is a steady increase in the dry matter accumulation in every stage of crop growth until harvest. Among different treatments T₉ - 25 days old seedlings with spacing 30×30 cm recorded significantly highest dry matter accumulation (605 kg ha⁻¹, 1421 kg ha⁻¹, 3002 kg ha⁻¹, 4660 kg ha⁻¹) at branching initiation stage, flowering stage, siliqua development stage and at maturity stage respectively which is on par with T₆. The minimum dry matter accumulation was recorded in treatment T₁- Conventional sowing (dibbling) with spacing 45 x 15 cm without gap filling at all the growth stages i.e., at branching initiation (335 kg ha⁻¹), flowering stage (832 kg ha⁻¹), siliqua development stage (1822 kg ha⁻¹) and at maturity stage (2916 kg ha⁻¹). similar results were recorded by Mamun *et al.* (2014) and Das *et al.* (2019). With wider spacing and transplanting resulted in better root proliferation and root activities *i.e.*, more uptake of water and nutrients accumulating more dry matter over the conventional planting which restricted the root growth resulting in less accumulation of dry matter in the latter. Similar findings were observed in Chaudhary *et al.* (2016), Singh *et al.* (2006) and (Singh and Dixit,1989).

Significantly higher dry matter accumulation in 25 days old seedlings is due to more age of the seedling can do better utilization of natural resources effectively viz., solar radiation, soil moisture, space and nutrients and more amount of chlorophyll content which leads to high rate of photosynthesis as a result greater amount of dry matter accumulation takes place. similar results observed in Fatematuzzohora *et al.* (2020).

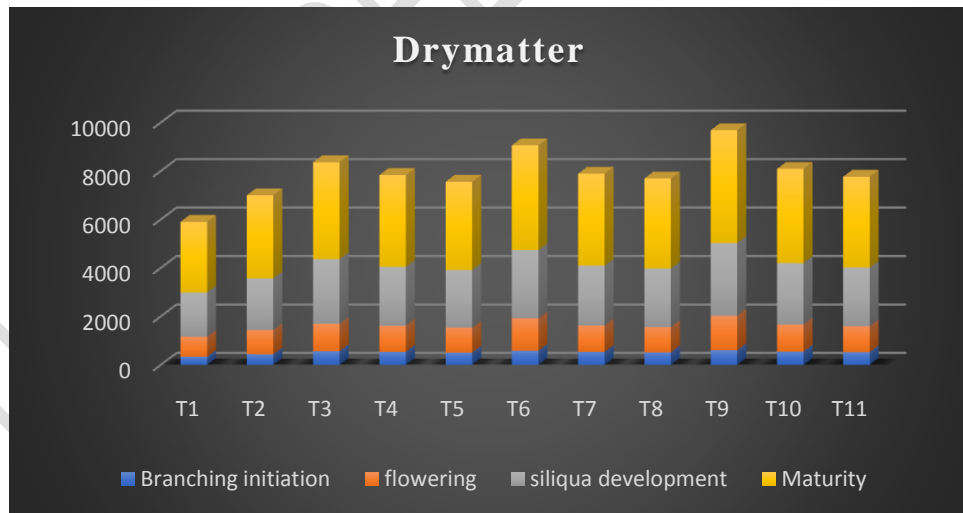


Plate 1 : Graphical distribution of **Dry matter accumulation in various treatments**

Number of primary branches plant⁻¹

Number of branches is the major character that directly relates to yield. Significantly higher number of primary branches plant⁻¹ was recorded in treatment T₁₁ i.e. 25 days old seedlings with spacing 60×60 cm (6.5, 8.4, 8.9 and 9.0) at branching initiation stage, flowering stage, siliqua development stage and at maturity stage respectively. Lowest number of primary branches plant⁻¹ recorded in Treatment T₁ i.e conventional sowing (dibbling) with spacing 45 x 15 cm without gap filling (3.7, 5.6, 6.1and 6.2) at branching

initiation stage, flowering stage, siliqua development stage and at maturity stage respectively.

Number of secondary branches plant⁻¹

Number of secondary branches plant⁻¹ play an important role in increasing seed yield of mustard. A perusal of the data revealed that number of secondary branches per plant followed the same trend as primary branches. The highest number of secondary branches plant⁻¹ was observed in T₁₁ - 25 days old seedlings with spacing 60×60 cm (23, 24.3 and 24.6) at flowering stage, siliqua development stage and at maturity stage respectively. Less number of secondary branches per plant recorded in T₁ - Conventional sowing (dibbling) with Spacing 45 x 15 cm without gap filling (7.4, 8.4 and 8.8) at flowering stage, siliqua development stage and at maturity stage respectively. It could be ascribed to less space for lateral growth and inter plant competition for sunlight, moisture and nutrients under narrow spacing more compared to wider spacing.

Higher number of branches might be due to lesser competition for resource exploitation among plants (Shivani and Kumar, 2002). Similar results were reported by Singh *et al.* (2006), Paraye *et al.* (2009) and Kumari *et al.* (2011). 25 days old seedling Transplanted with wider spacing resulted in more number of primary and secondary branches over the conventionally sown plants, due to minimum transplantation shock observed in older age of the seedlings with that they establish in the field quickly than younger seedlings. Similar findings reported by Ashok and Sajjan (2018)

Number of siliqua plant⁻¹

Number of siliquae plant⁻¹ is one of the important yield attributing traits that contributes to increasing seed yield of mustard. Significantly highest number of siliqua plant⁻¹ was recorded with T₁₁ - 25 days old seedlings with spacing 60×60 cm (656.3) which was on par with T₈ and T₅. The reduction in the number of siliqua plant⁻¹ under narrow spacing might be due to decline in light interception by plant canopy in comparison to higher spacing. Therefore, initiation of constituent buds on the secondary branches declined. The decrease in the number of secondary branches is the main cause of decline in number of siliqua plant⁻¹. In addition, the diminishing carbohydrate supply with exceeding competition among the plants at the time of flowering time is another reason (Eilkaee & Emam, 2003). Significantly higher no. of siliquae per plant in 25 days old seedlings is due to having more no. of lateral growth of the branches which produce the more siliqua per plant. This result was in consistent with those of Hosseini *et al.* (2006), Ozer (2003) . The lowest number of siliquae plant⁻¹ was noticed in T₁ - Conventional sowing (dibbling) with Spacing 45 x 15 cm without gap filling (130.4). similar findings observed in Singh *et al.* (2006).

Table 1. Effect of Plant geometry and Age of the seedlings on growth and yield attributes of mustard

Treatment	Plant Height (cm)	No. of primary branches/plant	No. of secondary branches/plant	Dry matter Production (kg ha ⁻¹)	No. of siliqua/plant	No. of seeds/siliquae
T ₁ - Conventional sowing + 45 x 15 cm without gap filling	116.5	6.2	8.8	2916	130.4	11.4
T ₂ - Conventional sowing + 45 x 15 cm with gap filling	152.6	6.4	11.7	3433	140.3	11.7
T ₃ -15 Days + 30 X 30 cm	179.4	6.7	19.4	4004	204.8	11.8
T ₄ -15 Days + 45 X 45 cm	170.1	8.0	20.4	3791	312.5	12.4
T ₅ -15 Days+ 60X 60 cm	155.2	8.4	22.5	3647	474.7	13.5
T ₆ -20 Days + 30 X 30 cm	181.7	7.6	19.5	4325	267.4	11.9
T ₇ -20 Days + 45X 45 cm	168.8	8.1	21.4	3796	323.4	12.5
T ₈ -20 Days + 60 X 60 cm	156.1	8.6	23.7	3720	526.1	14.5
T ₉ -25 Days + 30 X 30 cm	182.5	7.9	20.2	4660	275.3	12.3
T ₁₀ -25 Days + 45 X 45 cm	172.7	8.2	21.7	3888	471.7	12.7
T ₁₁ -25 Days + 60 X 60 cm	158.0	9.0	24.6	3753	656.3	14.7
S.Em+	2.5	0.2	0.7	127.2	53.0	0.6
CD@5%	7.4	0.7	1.9	375.2	156.3	1.8

Number of seeds siliqua⁻¹

Since seeds are generated as storage organs, the number of filled seeds is thought to be a significant component that directly contributes to utilizing potential yield recovery in oilseed crops. Among the treatments T₁₁ - 25 days old seedlings with spacing 60x60 cm (14.7) has recorded significantly higher number of seeds siliqua⁻¹ which was on par with T₈ and T₅ and the lowest with T₁ - Conventional sowing (dibbling) with Spacing 45 x 15 cm without gap filling (11.4). The lower seeds siliqua⁻¹ in closer spacing might be due to the more plant competition for absorbing environmental resources exceeds resulting in decrease in the production of photosynthetic materials and its transfer to seeds. Similar results were reported by Ozoni Davaji (2006) and Hasanuzzaman *et al.* (2007). Significantly more no. of seeds per siliqua recorded in 25 days old transplants might be due to efficient utilization of soil moisture, plant nutrients and they have more no. of siliquae per plant. Similar findings observed in Kumar *et al.* (2017).

CONCLUSION

From the above results transplanting 25 days old seedlings with 30 x 30 cm spacing recorded higher values of plant growth parameters plant height and drymatter accumulation and regarding yield attributes 25 days old seedlings transplanted with 60 x 60 cm recorded highest values per plant. Finally it can be concluded that transplanting 25 days old mustard seedlings with spacing 30 x 30 cm through system of mustard intensification (SMI) is more suitable for Northern Telangana Zone (NTZ).

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