Performance of Canola (*Brassica napus* L.) at Different Age of Seedling under System of Mustard Intensification

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**ABSTRACT**

**Background:** Rapeseed (*Brassica napus* L.) also known as ‘rape’ is bright yellow flowering member of family *Brassicaceae*, cultivated for its oil rich seed. It is third most important oilseed crop after soyabean and oil palm. Despite an important oilseed crop there is little advancement in suitable crop management strategies for improving crop productivity. The SRI has set of principles such as use of young seedlings, one seedling per hill, square planting, mechanical weeding, addition of organic matter. Recently the SRI is being successfully experimented in other crops such as wheat, maize, soyabean, blackgram, kidney bean, potato in the name of System of Crop Intensification.

**Methods:** This research experiment was carried out at the Student's Research Farm, Khalsa College, Amritsar during the rabi season of 2018-19. The Split plot design with three replications was carried under age of seedling in main plot treatments *A* [20 day seedling], *A* [30 day seedling] and *A* [40 day seedling] and four intra row spacing treatments in sub plots *S* [15 cm], *S* [30 cm], *S* [45 cm] and *S* [60 cm].

**Result:** Seed yield decreased progressively with increase in age of seedling. Wider spacing between plants (45 cm) observed high number of siliquae per plant than closer spacing (15 cm). Seed yield was significantly highest when crop was transplanted with 45 cm intra row spacing. The percent increase in seed yield in different SMI (System of Mustard Intensification) spacing treatments over closer spacing *S* [15 cm] were 21.62, 6.36, 4.89, per cent in *S* [30 cm], *S* [30 cm] and *S* [45 cm] respectively.

**Key words:** Canola, Intra row spacing, Seedling, System of mustard intensification.

**INTRODUCTION**

Rapeseed (*Brassica napus* L.) also known as ‘rape’ is bright yellow flowering member of family *Brassicaceae*, cultivated for its oil rich seed. *Brassica napus* L. originated from the Mediterranean region of South-West Europe from two contributing parents, *B. oleracea* and *B. rapa*, with natural hybridization (Saha *et al.*, 2008).

Rapeseed is third most important oilseed crop after Soyabean and Oil palm. Rapeseed is grown in more than 53 countries in the world. In 2017, world production of rapeseed was 76.2 MT from the 34.7 Mha area. Canada ranks first in production followed by China whereas Mexico ranks first in productivity (Anonymous 2017). The production of rapeseed in India is 8.32 MT from the 5.96 Mha area with average yield of 1397 kg/ha which contributes about 10 percent to the total production of world. The mostly cultivable states are Rajasthan, Haryana and Madhya Pradesh. Rajasthan has highest area under rapeseed as 2.18 Mha with production of 3.40 MT. (Anonymous 2018). In Punjab, it was cultivated at 0.032 Mha area with a production of 0.04 MT and 1413 kg/ha productivity in 2017. (Anonymous 2019).

In North America, the term “canola”-a contraction of Canada and ola, meaning oil, became widely used to refer to rapeseed and is now a trade-name for “double low” (low erucic acid and low glucosinolate) rapeseed. Basically Canola is species of Brassica varieties having less than 2 percent erucic acid in the oil and less than 30 micro moles glucosinolates per gram of defatted meal. It is also termed as ‘double low’ or ‘00’ rapeseed (Saleem *et al.*, 2001) and sometimes as LEAR (low erucic acid rapeseed). It is low in saturated fatty acids (6%) compare to flex seed oil (9%), sunflower oil (12%), corn oil (13%), olive oil (15%), soybean oil (15%), peanut oil (19%) and palm oil (51%).

The National requirement of edible oil is going to increase even further in coming years due to high population growth rate and increase in per capita consumption. Adoption of suitable crop management practices are important factors for improving crop productivity. The production barrier can be effectively overcome through adoption of appropriate interventions and technologies. To meet future needs for food, one potentially promising technology for yield enhancement is system of crop intensification developed in 1980 in Madagascar. SRI (System of Rice Intensification) is a promising rural innovation that has been developed outside of the formal research system. In the recent, the successful SRI practices...
are being experimented to other crops such as wheat, maize, soybean, blackgram, kidney bean, lentil, mustard, sugarcane, tomato, brinjal, chilli, potato and carrot in the name of System of Crop Intensification (SCI). In pursuit of extending the beneficial effect of SCI, the present study is programmed in Mustard. Adoption of SCI practices in Mustard may enhance the productivity and reduce the gap between per capita availability.

System of Crop Intensification mainly emphasises on utilizing early growth vigor of seedlings, facilitates less competition for light and nutrients, enhances resource use efficiency (seeds, water, fertilizer, pesticides) and brings down over dependence on chemical fertilizers promoting healthy root growth and increased soil microbial activity and there by enhancing soil organic matter content.

SCI (System of Crop Intensification) is primarily based on these two principles of crop production first principle of root development and second principle of intensive care. Root development is the first step of healthy growth and development of any plant. For this, it requires proper nourishment and sufficient space around the plant. Hence, distance between plants is very crucial for proper growth and development of crop plants that holds the principle of root development. Intensification does not mean high number of plant density per unit space, rather it is proper space maintenance and taking care of plant very closely.

MATERIALS AND METHODS

The experiment was conducted in rabi season of 2018-19 at Student’s Research Farm, Khalsa College Amritsar, India (31.63’N latitude and 74.83’E longitude and at an altitude of 234 m from sea level). The weekly mean temperature recorded during crop period ranged between 9.6°C in the 52nd SMW (25-31 December) and 22.3°C in the 13th SMW (26 March-1 April), whereas maximum and minimum temperature for crop growth period was 30.9°C and 1.6°C respectively. Rainfall of 144.2 mm was recorded in 10 rainy days over 52 days during crop season. Soil of experimental field was sandy loam in texture, normal in reaction and EC (0.34 dSm-1).

Soil preparation and mixing of organic manure was done before starting the experiment. Farmyard manure (1.4 tonnes) was applied at the time of field preparation and mixed properly. Basal application of 2/3 recommended dose of nitrogen was applied through urea (27 kg) after 15 days of sowing, 1/3 remaining dose of nitrogen through urea (13.5 kg) was applied 35 days after sowing. Vermicompost (73 kg) was applied after 20 days of transplanting. Recommended dose of Potassium was given through muriate of potash (13.5 kg) after 50 days of transplanting as per SMI manual. Nursery of crop (20 days, 30 days, 40 days seedlings) was transplanted in main experimental field manually on 20th October by broadcasting on broad beds for 40 day, 30 day and 20 day nursery and were transplanted in twelve treatment combinations with three replications under Split plot design (SPD) and each consisted of A1 x S1, A1 x S2, A1 x S3, A1 x S4, A2 x S1, A2 x S2, A2 x S3, A2 x S4, A3 x S1, A3 x S2, A3 x S3, A3 x S4.

After thorough field preparation, thirty six plots of 4.5 m x 4.5 m were made as per experimental design. Farmyard manure (1.4 tonnes) was applied at the time of field preparation and mixed properly. Basal application of 2/3 recommended dose of nitrogen was applied through urea (27 kg) after 15 days of sowing, 1/3 remaining dose of nitrogen through urea (13.5 kg) was applied 35 days after sowing. Vermicompost (73 kg) was applied after 20 days of transplanting. Recommended dose of Potassium was given through muriate of potash (13.5 kg) after 50 days of transplanting as per SMI manual. Nursery of crop (20 days, 30 days, 40 days seedlings) was transplanted in main experimental field manually on 20th November in the irrigated field. The spacing was kept as per the intra row spacing treatments, keeping inter row spacing at 45 cm.

RESULTS AND DISCUSSION

Yield and yield attributes

Yield attributes

Yield contributing characters showed non-significant differences with respect to age of seedling and intra row spacing (Table 1). However treatment A3 showed numerically better results than treatments A1 and A2 in all yield contributing characters. Singh (2010) also reported non-significant effect of age of seedling and intra row spacing in

Table 1: Different yield attributes as influenced by age of seedling under system of Mustard Intensification in Canola.

| Treatment | Length of siliquae (cm) | No. of seeds per siliquae | No. of siliquae per plant | Thousand seed weight (gm) |
|-----------|-------------------------|---------------------------|---------------------------|---------------------------|
| Age of seedling (days) | | | | |
| A1 (20) | 7.88 | 24.70 | 425.70 | 3.68 |
| A2 (30) | 7.53 | 23.70 | 427.37 | 3.65 |
| A3 (40) | 7.78 | 23.33 | 386.83 | 3.65 |
| C.D(P=0.05) | NS | NS | NS | NS |
| Intra row spacing (cm) | | | | |
| S1 (15) | 7.61 | 21.5 | 185.94 | 3.53 |
| S2 (30) | 7.75 | 23.83 | 338.05 | 3.62 |
| S3 (45) | 7.77 | 25.22 | 513.27 | 3.79 |
| S4 (60) | 7.77 | 25.11 | 615.94 | 3.68 |
| C.D(P=0.05) | NS | NS | 49.85 | NS |

Discussion

The results indicate the following:

1. **Age of Seedling**
   - Treatment A3 (40 days) showed the highest yield contributing characters compared to A1 (20 days) and A2 (30 days).
   - There was no significant difference between A1 and A2 in the yield contributing characters.

2. **Intra Row Spacing**
   - S2 (30 cm) showed the highest yield contributing characters compared to S1 (15 cm) and S3 (45 cm).
   - S4 (60 cm) showed marginally lower yield compared to S2.

The observations suggest that 40 days age of seedling and 30 cm intra row spacing may be the optimal parameters for increasing yield contributing characters in Mustard under SCI. Further research is needed to validate these findings and to explore the potential of SCI in enhancing productivity and reducing input dependency.
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length of siliquae and number of seeds per siliquae. Maximum number of siliquae per plant were produced by treatment A₂, which might be due to better establishment of younger seedling. Treatment S₄ recorded the highest mean for number of siliquae (615.94) which were significantly higher from all other treatments. The increase in number of siliquae in treatments S₃, S₂, S₁ over treatment S₁ were 231.25, 176.04 and 81.80 percent respectively as shown in Table 2. It may be due to more number of primary and secondary branches Chaudhary et al. (2015).

**Seed yield (q/ha)**

The data indicated that age of seedling did not significantly influenced the seed yield, but numerically treatment A₂ produce 0.81% and 4.64% more yield than treatment A₁ and A₃ respectively (Table 2). Further data revealed that among SMI spacing treatments, treatment S₃ produced higher yield as compared to other treatments. The percent increase in seed yield in different SMI spacing treatments over treatment S₁ were 21.62, 6.36 and 4.89 percent respectively in S₁, S₂ and S₃ respectively. SMI treatment S₃ has lowest seed yield as high plant density tends to have more vegetative growth and lesser yield attributes due to severe competition between plants. Treatment S₃ produce higher yield as compared to others as wider spacing enhanced number of leaves, dry matter accumulation and yield parameters like better 1000 seed weight, siliquae per plant (Table 1). This is in line with findings of Chaudhary et al. (2015).

**Stover yield (q/ha)**

The stover yield of system of mustard intensification (SMI) was non-significant by age of seedling treatments. Highest mean straw yield of crop was obtained by treatment A₂ (81.35 q/ha) which was statistically similar to other treatments. Among intra row spacing treatments in SMI, treatment S₁ (90.51 q/ha) produced significantly higher straw yield than other intra row treatments. The trend of percent increase in stover yield due to SMI in different treatments over S₁ was S₃ > S₂ > S₁. The higher stover yield in S₃ could be taken as a function of more branches per plant. Similar results were reported by Pal (2001).

**Economics**

The data revealed that among the all treatments, maximum cost of production was resulted from treatment A₁ x S₃ and A₂ x S₄ i.e. (20 day seedling+45cm*45cm) and (30 day seedling + 45cm*45cm) respectively. The highest net return obtained from treatment A₁ x S₃ followed by A₂ x S₄, and lowest in treatment A₃ x S₁. Maximum B:C ratio of 1.23 was observed under treatment A₁ x S₃ and A₂ x S₄.

**CONCLUSION**

The present study revealed that age of seedling had not significant effect on yield in canola. However wider spacing treatment S₃ (45 cm intra row spacing) in system of mustard intensification showed significantly higher yield attributes i.e. siliquae per plant and seed yield. The higher B:C ratio (1.23) was recorded in 20 and 30 days old seedling when it was transplanted at 45 cm intra row spacing in transplanted canola. Thus, it can be concluded that adoption of SRI

### Table 2: Seed yield, Stover yield as influenced by age of seedling under system of Mustard Intensification in Canola.

| Treatments | Seed yield (q/ha) | Stover yield (q/ha) |
|------------|------------------|---------------------|
| Age of seedling (days) |
| A₁ (20) | 20.7 | 80.6 |
| A₂ (30) | 20.9 | 81.3 |
| A₃ (40) | 20.0 | 78.0 |
| C.D(P=0.05) | NS | NS |
| Intra row spacing (cm) |
| S₁ (15) | 19.0 | 90.5 |
| S₂ (30) | 19.9 | 83.4 |
| S₃ (45) | 23.1 | 76.0 |
| S₄ (60) | 20.2 | 70.1 |
| C.D(P=0.05) | 1.18 | 6.97 |
| Interaction | NS | NS |

**Fig 1:** Seed yield and Stover yield as effected by different treatments of system of mustard intensification.
techniques in mustard crop may enhance the productivity and increase the yield potential.

REFERENCES
Anonymous (2017). www.fao.org/faostat/en/home, FAOSTAT OF UN.
Anonymous (2018). Directorate of Economics and Statistics, DAC and FW 2018.
Anonymous (2019). Package and practices of rabi crops 2019, Punjab Agriculture University, Ludhiana, India.
Chaudhary, S., Shukla, A., Bhushan, C. and Negi, M.S. (2016). Assessment of the system of root intensification in rapeseed-mustard (Brassica species). Indian Journal of Agronomy. 61(1): 119-122.
Pal, R. (2001). Comparative performance of transplanted canola (Brassica napus L.) genotypes in relation to intra-row spacing and age of seedlings. M. Sc. Thesis, Punjab Agricultural University, Ludhiana, India.
Pradan (2009). Cultivating Rapeseed/Mustard with SRI Principles. A Training Manual.
Saha, S., Molla, R., Chandra, D. and Rahman, L. (2008). Assessment of genetic variation and relationships within the varieties of four Brassica species by RAPD markers. Australian Journal of Crop Science. 2: 105-114.
Saleem, M., Cheema, M.A. and Malik, M.A. (2001). Agro-economic assessment of canola planted under different levels of nitrogen and row spacing. International Journal of Agriculture and Biology. 3: 1560-8530.
Singh, A. (2010). Influence of nursery age and inter row spacing on growth and yield of canola (Brassica napus L.) varieties. M. Sc. Thesis, Punjab Agricultural University, Ludhiana, India.