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Effect of Cultivars and Date of Transplanting on Growth and Productivity of Mustard in Lateritic Soil of West Bengal

Sandip Kumar De[1], Amit Kumar Sinha[1] and Kalipada Pramanik[2*]

[1]Dept. of Agronomy, RMD CARS, Ambikapur, Chhattisgarh (497 001), India
[2]Dept. of Agronomy, Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, West Bengal (731 236), India

Corresponding Author

Kalipada Pramanik
e-mail: kalipada.pramanik@visva-bharati.ac.in

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Abstract

Time of sowing is one of the most important non-monetary input for crop production, particularly for rabi crops. Late harvesting of aman paddy severely affects the yield of mustard crop. Early planting through seedling of mustard can compensate the late planting at least 14 days. Under this circumstance, the use of appropriate cultivar along with timely transplanting of Indian mustard can produce higher yield under mild winter in eastern India under lateritic soil condition in late harvesting of aman paddy. A field experiment was conducted during the *Rabi* season of 2020-21 at Agricultural farm of Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati, Sriniketan, West Bengal, to study the effect of mustard (*Brassica juncea* L.) cultivars and date of transplanting on productivity. The experiment conducted in Factorial RBD with three cultivars viz., NRCHB 101, Kesari Gold and Kesari 5111 and four dates of transplanting viz., 3rd November, 14th November, 25th November and 6th December. Result showed that different crop cultivars and dates of transplanting significantly influenced growth and yield of mustard crop. Kesari Gold cultivar recorded maximum plant height, dry matter accumulation, leaf area plant^{-1}, number of branches plant^{-1} (7.51), number of siliqua plant^{-1} (540.2) and number of seed siliqua^{-1} (13.25) and highest seed yield (1107 kg ha^{-1}) over other two cultivars, whereas, the mustards transplanted on 3rd November recorded highest growth attributes, yield components and seed yield (1361 kg ha^{-1}) over the other three dates of transplanting.

Keywords: Indian mustard, kesari gold, transplanting, yield

1. Introduction

Sustainably feeding the world's growing population is a great challenge (Tilman et al., 2002, 2011; Godfray et al., 2010), and closing the yield gaps especially on smallholder farms (Lobell et al., 2009; Mueller et al., 2012; Van Ittersum et al., 2013) is a vital strategy to address that challenge (Foley et al., 2011). There is a huge yield gap between the yield of experimental station and farmers' field, particularly in oilseed crops. Oilseed crops are one of the most important crops in the world. These are promising crops with high abilities to improve human diets, prevent malnutrition and food insecurity and to provide employment through income generation in the society. Canada is the largest producer of oilseed brassica and holds major market followed by China. India stands second in terms of area and production after Canada and in terms of yield ha^{-1}, world is 1.99 t ha^{-1}, Canada is 2.28 t ha^{-1}, China is 2.06 t ha^{-1} whereas India's yield is only 1.04 t ha^{-1} (Anonymous, 2021). Mustard (*Brassica juncea* L.) is the 3rd most important edible oilseed crop of the world after the Soybean and palm oil. Although, India is the leading oil producing country in the world, but it is unable to meet the requirement of edible oil for its large growing human community. Mustard (*Brassica juncea* L.) is commonly known as rai. Mustard seeds have high energy content, having 28–32% oil with relatively high protein content (28–36%). Mustard oil has a special fatty acid composition, it contains about 20–28% oleic acid, 10–12% linoleic, 9.0–9.5% linolenic acid, and 30–40% erucic acid, which is indigestible for animal and human and organisms (Al-Jasser and Al-Jasser, 2012). Mustard oil is rich in tocopherols, as a consequence of their antioxidant characteristic, they act as a preservative against rancidity (Moser et al., 2009).

It is a winter (*Rabi*) season crop that requires relatively cool temperature, a fair supply of soil moisture during the growing season and a dry harvest period (Banerjee et al., 2010). The major rapeseed-mustard growing states are Rajasthan, Madhya Pradesh, Haryana, Uttar Pradesh, West Bengal and Gujarat. It is also grown under some non-traditional areas of South India including Karnataka, Tamil Nadu, and Andhra Pradesh. In west Bengal, the area under mustard cultivation is 0.62 mha with production of 0.72 mt and productivity 1171 kg ha^{-1} (2019–20) (Anonymous, 2019). The productivity of mustard is lower than national average.

Among the several reasons responsible for low productivity of mustard, grown in residual moisture condition, photo-thermo sensitivity nature, non-adoption of good agronomic practices like optimum date of sowing and planting geometry are the most important. Time of sowing is one of the most important nonmonetary input for increasing dry matter accumulation and to provide most favourable atmosphere for better light interception and the maximum utilization of nutrients and moisture which helps healthier plant growth and seed yield of crops. Rapeseed-mustard is noticeably sensitive to weather as shown from the variable response to different sowing dates (Kumar et al., 2000). One month delay in sowing from mid-October resulted in loss of 40.6% in seed yield (Lallu et al., 2010). The secret of boosting its yields mainly lies with suitable sowing date (Kithan et al., 2020).

Plant population and date of sowing much affected the yield and yield parameters. 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 to minimize the yield loss in mustard. The transplanting method can also increase the crop intensity as duration of crop in the field is decreased by at least 10–15 days without hampering the productivity. Through, transplanting method nutrients can be supplied specifically and intra-competition is reduced as spacing is predetermined. Residual moisture of previous crop is also utilized. Transplanting of mustard has also been reported thereby saving time, and resources. Transplanting reduces days to maturity and results in higher seed yield (Shekhawat et al., 2012). Keeping in view of date of transplanting facts a field experiment was conducted with three mustard cultivars to study the “Effect of cultivars and date of transplanting on growth and productivity of mustard in lateritic soil of West Bengal”.

2. Materials and Methods

A field experiment was conducted during the *rabi* (October to March) season of 2020–21 at Agricultural farm of Palli Siksha Bhavana, Visva-Bharati, Sriniketan, West Bengal. The geographical location of Sriniketan is about 20°39'N latitude and 87°42'E longitude with an average altitude of 58.9 meters above mean sea level and soil pH of the field was 6.01. The experiment was laid out in factorial RBD with twelve treatments each of which replicated thrice. Treatment consists of three cultivars (NRCHB 101, Kesari Gold and Kesari 5111) and four dates of transplanting (3rd November, 14th November, 25th November and 6th December). Seedling pots or seed micro-pots are made up of PVC pipe materials. In the ratio of 2:1, soil and vermicompost were taken and thoroughly mixed with each other and filled each micro pots with this mixture. One seed was sown in each micro pot and covered the seeds with vermicompost. Pot-trays were watered regularly in the morning and in the evening until the seeds germinate. Frequent sprinkling of water also was given after emergence of seedlings on the basis of visual moisture stress symptoms. Seedlings were raised in pots for 14 days. The plot size was 4.5×4.5 m^2 and spacing was 45×45 cm^2. The crop was transplanted with a fertilizer dose of 120:60:60 for N:P_2O_5:K_2O where full dose of P_2O_5 and 3/4th dose of K_2O and half of N were applied as basal in the time of transplanting as band placement in hole made by hole making implement. First top dressing at 40 DAT 1/4th of N and second top dressing at 60 DAT rest of 1/4th of N and 1/4th of K_2O were applied. Five plants from each plot were randomly selected at harvesting and the average height of the plant for each plot was determined. For determining leaf area and dry matter accumulation, five mustard plants were cut at ground level from each plot at 75 DAT. For measuring leaf area, leaf area meter was used. For dry matter accumulation, sample was dried in a hot air oven, kept at 65°C for 48 hours till constant weight were obtained. At harvesting, ten plants were randomly selected for determining number of branches plant^{-1}, number of siliquae plant^{-1} and number of seeds siliqua^{-1}. After harvesting the seeds were dried and then winnowing, cleaning, weighing etc. were done and yields were calculated.

3. Results and Discussion

3.1. Effect on growth parameters

3.1.1. Plant height

At harvest, plant height of Kesari Gold cultivar (140.4 cm) was recorded significantly higher plant height over Kesari 5111 (127.4 cm) but it was at par with NRCHB 101 (137.0 cm) in table 1. The higher plant height with Kesari Gold might be due to the genetic potentiality of the that cultivar. Mustard crop transplanted on 3rd November recorded significantly maximum plant height (153.6 cm) over the three dates of transplanting. It might be due to longer crop duration and favourable agrometeorological conditions. The findings of the present study also confirmed by Alam et al. (2015) and Bazzaz et al. (2020).

3.1.2. Dry matter accumulation

Dry matter accumulation (DMA) data recorded at 75 DAT showed the significant effect of cultivar as well as date of transplanting on dry matter accumulation of mustard crop (Table 1). The cultivar Kesari Gold (42.31 g plant^{-1}) was recorded significantly higher DMA over Kesari 5111 (34.30 g plant^{-1}) but it was at par with NRCHB 101 (39.88 g plant^{-1}) in Table 1. The higher DMA of Kesari Gold might be due to different genetic make-up. Similarly, due to higher plant height and other favourable conditions the mustard transplanted on 3rd November recorded highest DMA (55.74 g plant^{-1}) over others date of transplanting. Keerthi et al. (2017) and Bazzaz et al. (2020) also stated similar results.

3.1.3. Leaf area plant^{-1}

Leaf area plant^{-1} recorded by Kesari Gold cultivar (316.1 cm^2) significantly greater over Kesari 5111 (262.2 cm^2), but it was at par with NRCHB 101 (290.6 cm^2) at 75 DAT due to different genetic expression (Table 1). Similarly, at 75 DAT, mustard crop transplanted on 3rd November recorded significantly higher leaf area plant^{-1} (436.6 cm^2) over other transplanting dates might be due to higher dry matter accumulation and early establishment of mustard crop under optimum weather condition.

3.2. Effect on yield parameters and productivity

3.2.1. Number of branches

The number of branches of Kesari Gold (7.51) significantly higher over Kesari 5111 (7.07) but it was at par with NRCHB 101 (7.33) might be due to different genetic potential of the cultivars (Table 1). The crop transplanted on 3rd November recorded significantly higher number of branches (8.58) over other transplanting dates. Delayed transplanting recorded a smaller number of branches might be due to late sown crops faced high-temperature stress that ultimately decreased stand established and growth of the plant finally reduced the branches. Afroz et al. (2011) and Bazzaz et al. (2020) also reported similar findings.

3.2.2. Number of siliquae plant^{-1}

The Kesari Gold cultivar recorded highest siliquae plant^{-1} (540.2) over cultivar NRCHB 101 (470.3) and Kesari 5111 (456.0) might be due to higher dry matter and plant height and also superior genetic potential of Kesari Gold (Table 1). In case of date of transplanting, 3rd November transplanted mustards recorded highest number of siliquae plant^{-1} (689.9) over other transplanting dates. Higher value might be due to early crop establishment, better biomass production and longer crop duration. Mondal et al. (1999), Aziz et al. (2011) and Gawariya et al. (2015) supported the results.

Table 1: Effect of cultivar and date of transplanting on growth parameters, yield attributes and yield of mustard crop

Treatments	Plant height at harvest (cm)	Dry matter accumulation (g m^{-2}) at 75 DAT	Leaf area plant^{-1} (cm^2) at 75 DAT	No. of branches plant^{-1}	No. of siliquae plant^{-1}	No. of seeds siliqua^{-1}	Seed yield (kg ha^{-1})
Cultivar							
NRCHB 101	137.0	39.88	290.6	7.33	470.3	12.60	867
Kesari Gold	140.4	42.31	316.6	7.51	540.2	13.25	1107
Kesari 5111	127.4	34.30	262.2	7.07	456.0	12.69	819
SEm±	1.25	1.14	10.54	0.08	9.15	0.10	34
LSD (p=0.05)	4.23	3.86	35.68	0.28	30.98	0.34	100
Date of transplanting							
3rd November	153.6	55.74	436.6	8.58	689.9	14.47	1361
14th November	141.9	46.10	284.2	8.13	549.2	13.15	962
25th November	135.7	33.55	261.0	7.19	483.7	12.53	823
6th December	108.4	19.93	176.8	5.30	232.5	11.23	578
SEm±	1.25	1.14	10.54	0.08	9.15	0.10	29
LSD (p=0.05)	3.66	3.34	30.90	0.25	26.83	0.29	86

3.2.3. Number of seeds siliqua^{-1}

Significantly the highest number of seeds siliqua^{-1} (13.25) was recorded with crop cultivar Kesari Gold over Kesari 5111 (12.69) and NRCHB 101 (12.60) due to genetic superiority (Table 1). Mustard crop transplanted on 3rd November was recorded significantly higher number of seeds siliqua^{-1} (14.47) over 14th November, 25th November and 6th December. It might be due to vigorous growth of crop and more supply of photosynthate to large number of sinks under favourable agrometeorological conditions. Similar findings reported by Bhuiyan et al. (2008), Aziz et al. (2011) and Singh and Singh (2017).

3.2.4. Seed yield

Better growth attributes and favourable yield parameters and superior genetic make-up resulted greater seed yield of Kesari Gold cultivar (1107 kg ha^{-1}) over NRCHB 101 (867 kg ha^{-1}) and Kesari 5111 (819 kg ha^{-1}) (Table1). The crop transplanted on 3rd November, was recorded significantly higher seed yield (1361 kg ha^{-1}) over crop transplanted on 14th November (962 kg ha^{-1}) and 25th November (823 kg ha^{-1}) and 6th December (578 kg ha^{-1}). The higher seed yield recorded with 3rd November transplanting might be attributed to higher number of branches and siliquae in individual plants, number of seeds siliqua^{-1} and other growth parameters. Mondal et al. (1999), Somondal et al. (2014) and Bazzaz et al. (2020) also reported similar findings.

4. Conclusion

From the above experiment it can be concluded the different mustard cultivar and date of transplanting significantly influenced the growth and yield parameters as well as the productivity. All of tested cultivars were highly productive that transplanted on 3rd November over the other transplanting dates. However, cultivar Kesari Gold was most suitable in the changing agrometeorological conditions.

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