ISSN: 2287-688X

Annals of
Plant Sciences

Volume 11, Issue 01 (2022) pp. 4670-4678

Research Article

A Study on the Performance of Different Rapeseed-Mustard Varieties under Late Sown Condition of Jaintia Hills of Meghalaya

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Abstract

A field experiment entitled **"A study on the performance of different rapeseed-mustard varieties under late sown condition of Jaintia Hills of Meghalaya"** was conducted in The District and Local Research Station, Jowai, Meghalaya, during *rabi* season of 2020-2021. The experiment consisted of eight rapeseed-mustard varieties namely PM-26, PM-27, NRCHB-101, SURBHI, BULLET, ANMOL, LOCAL (Meghalaya), LOCAL (Assam) which were laid out in Randomized Block Design (RBD) with three replications, to study the growth and yield performance of different rapeseed-mustard varieties and as well to find out the best suitable variety under late sown condition of Jaintia Hill of Meghalaya. The results revealed that there was a significant difference among all the rapeseed-mustard varieties for all the growth and yield attributes studied. Among the eight rapeseed-mustard varieties, it is found out that the variety NRCHB-101 perform the best and very suitable to the condition, followed by the variety SURBHI, BULLET and ANMOL. The variety (NRCHB-101) showed significantly higher plant height (151.77 cm), number of branches^{-1} (13.25), number of siliqua plant^{-1} (159), seeds siliqua^{-1} (13.25), seed yield (1631.04 kg ha^{-1}), stover yield (4261.84 kg ha^{-1}) and oil yield with 442.56 (kg ha^{-1}). Further, mean result of the study revealed that highest gross returns (Rs 75841.51) , net returns (Rs 52561.51) and B:C rartio (3.25) was recorded in the variety NRCHB-101. Therefore, NRCHB-101 can be recommended for cultivation under late sown condition of Jaintia Hils of Meghalaya.

Keywords: *Rapeseed-Mustard, Varieties, Growth, Yield attributes and Yield.*

Introduction

Rapeseed-mustard (*Brassica spp* L.), is India's second most important edible oilseed crop after peanuts. The rapeseed-mustard oil proportion fluctuates between 37 and 49 percent. Mustard (*Brassica juncea* L.) is an annual plant in the *Brassica* family. Mustard is named after the Latin word *mustum*, which meaning "mustard" (Hemingway. 1976). It's also produced in a variety of tropical and subtropical climates as a cold-weather crop. Rapeseed-mustard (*Brassica* spp) is India's and the world's second-largest oilseed crop, trailing only soybean in terms of area.

Rapeseed-mustard also adds significantly to the country's total oilseed production. Because of its short lifespan, extensive adaptation to diverse agro-climatic areas and soil types, and photo-insensitivity, it is also an important oilseed crop. Rapeseed-mustard is an important edible oilseed farmed in India, accounting for 28.6% of total oilseed production. The global production of rapeseed-mustard and its oil is estimated to be between 38 and 42 million tonnes and 12-14 million tonnes, respectively. Oilseed crops have long been the backbone of India's agricultural-based economy. India is now one

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DOI: http://dx.doi.org/10.21746/aps.2022.11.01.15

of the world's leading producers of oilseeds. During the 2003-04 fiscal years, it produced an estimated 25.14 million tonnes (Sadeesh. *et al*., 2006). Rapeseed-mustard is a major source of edible oil in India, followed by groundnuts (Panday. *et al*., 1999). Because of late maturity and pot cracking due to high temperatures during harvest in Feb-Mar, rapeseed-mustard cultivation is limited to northern India (Dutt and Chopra. 2001). Rapeseed-mustard is the most popular oilseed for consumption among the inhabitants of India's North Eastern Region (NER), however it is not currently farmed on a significant scale.

The NEH region's oilseed status is barren and underappreciated. Production in North Eastern India is significantly lower. Despite the fact that India was self-sufficient in edible oil until the 1990s, the North Eastern states have all been in deficit since the 1960s. As a result, KVKs under ATARI launched a programme named "Cluster Frontline Demonstration under National Mission on Oilseed and Oil Palm (NMOOP)" to boost oilseed production in the North East.

Moving on to Meghalaya, the most important oilseed crop grown there is rapeseed-mustard. The Garo Hills produce the majority of rapeseed-mustard, accounting for up to 96 percent of rapeseed-mustard area and 97 percent of rapeseed-mustard output, respectively. Despite accounting for 9.29 percent of total oilseed production and 4.86 percent of the north east region's area in 2010-2011, rapeseed-mustard accounted for 21.13 percent of total oilseed area and 23.32 percent of total production (Anonymous. 2012). Because of the lack of HYV of the rapeseed mustard crop, widespread infestation by insects and pests, destruction of crops owing to hilly track as well as *Jhum* farming, insufficient and irregular water supply due to variations in rainfall throughout the period, and so on, the yield growth rate is low. Untimely seeding with local types, poor crop stand, inadequate nutrition, moisture stress, and nearly no plant defences could all contribute to the low yield. Due to its cultivation in soils with residual or marginal fertility, as well as retained soil moisture, productivity is further limited (Ray. *et al*., 2016). As a result, correct agronomic management approaches are critical for achieving increased rapeseed-mustard yield potential. Improved agro-techniques, such as the use of improved cultivars, timely sowing, ridge and furrow sowing, adequate nutrient supply, irrigation at critical stages, chemical weed management at critical periods (15-40 DAS), and the use of plant growth regulators (PGR), are the keys to achieving higher crop productivity in developed countries with fertile land, on the other hand. Crop growth and yield are influenced by cultural management strategies such as cultivar selection, planting time, and cultivar life cycle duration (Sheoran. *et al*., 2014). As a result, finding an appropriate rapeseed-mustard cultivar that can perform well under delayed seeding (after *kharif* rice harvesting) in Meghalaya, particularly under assured irrigation and NPK fertilization.

Materials and Methods

The field experiment was carried out in the The District and Local Research Station, Jowai, Meghalaya. The farm is situated in the foot hills of Jowai at an altitude of 1200 meters above mean sea level with the geographical location at 25° 45′ 43" North latitude and 95° 53' 04" East longitude.

The average temperature during summer varies from 15-30°C while during winter it varies from 3-24°C. The average rainfall varies from 2500-3500 mm starting from April whereas in the months of November-March, it is dry. The soil of the experimental plot was found to be acidic, well drained and sandy loam in texture. The experiment has been done with the following treatments as follows PM-26, PM-27, NRCHB-101, SURBHI, BULLET, ANMOL, LOCAL (Meghalaya) and LOCAL (Assam). These varieties were collected from ICAR Research Complex for NEH, Barapani and some were purchased from Guwahati Kisan seeds centre. The cultivation practices was same for all the treatments. Observation to be recorded on 8 rapeseed-mustard varieties *Viz*., growth and

yield attributes. The growth attributes are Plant height (cm), Plant population, Number of branches per plant at harvest, Leaf area index, Crop growth rate, Relative growth rate and Phenological parameters are days to 50 % flowering and days to maturity. Yield attributes were, Number of siliqua per plant, Siliqua length (cm), Number of seeds per siliqua, Test weight (1000 seeds weight), Seed yield (kg/ha), Stover yield (kg/ha), Harvest Index (%), Oil content (%) and Oil yield (Kg/ha). Economic analysis were Cost of cultivation (Rs/ha), Gross return (Rs/ha), Net return (Rs/ha), Benefit:Cost ratio and statistical analysis. Determination of nutrient status of the soil before sowing and after harvesting of the crop were observed and recorded from all the 24 plots.

Results and Discussion

The results of various parameters are discussed in this chapter. The periodical observations on the plant growth, phenological parameters, yield attributes. The data noted for progressive of rapeseed-mustard plant height (cm) at harvesting stage were presented in the Table 1 and also depicted in Fig 1. The variety NRCHB-101 recorded the tallest plant height over all the remaining varieties at crop harvest (157.77 cm), second tallest variety were recorded in BULLET at crop harvest (142.95). The lowest plant height were recorded in the variety PM-26 with 89.30 cm. A plant's height is governed by genetical characteristics, and different varieties will grow to varying heights depending on their genetic make-up in a given environment, (Dongarkar. *et al.*, 2005). The variations in plant population/m^{-2} were found in different varieties. Maximum plant population were recorded in the variety PM-26 with 19.29 plants/m^{-2} at harvest followed by PM-27 (18.88) and NRCHB-101 (17.22). Minimum plant population were recorded in the variety ANMOL with 15.73 plants/m^{-2} at harvest. The mortality of plant populations has been reported to reduce throughout the early phases of crop growth. It was observed that the number of branches in each variety varied and increased as the crop progressed toward flowering. Variable rapeseed-mustard varieties had a substantial impact on flowering characters at the productive section of the flowering development stages, which could be attributed to different crop growth maturity patterns over the entire life cycle growth period (Kumar. *et al*., 2017). The number of branches at harvest were recorded highest in the variety NRCHB-101 with 13.25 number of branches followed by the variety BULLET with 12.04 number of branches and the lowest was recorded in the variety PM-26 with only 7.03 number of branches. The genetic makeup of the crop and climatic conditions, both of which have a substantial impact on the crop's final seed yield, result in a higher number of branches per plant (Helal. *et al*., 2016). Leaf area index differed significantly due to varietal effect, at 60 DAS the highest LAI was recorded in the variety LOCAL (Meghalaya) LAI of 0.82 and the lowest LAI was recorded in the variety SURBHI with 0.55 LAI. The higher values in LAI is due to an increase in vegetative development, which led to more light interception and thus a rise in the plant's leaf area index. The crop growth rate is detected across all 8 varieties, the variety PM-26 recorded the greatest CGR of 2.09 g m^{-2} day^{-1}. While the lowest crop growth rate at 30-60 DAS was recorded in the variety BULLET with 1.61 g m^{-2} day^{-1}. The higher the LAI, the faster the total dry matter building will be, according to Khan and Khalil (2010), especially when the reproduction stage begins. The pace of crop growth in rapeseed-mustard cultivars changed throughout time. CGR and LAI have a good relationship (Anonymous. 1987). The relative growth rate was recorded highest in the varieties PM-26 with 0.039 g $g^{-1}day^{-1}$, the lowest RGR was obtained in the varieties PM-27 and ANMOL, both 0.033 g $g^{-1}day^{-1}$. The CGR value was low at the start of the crop's growth because the LAI value was low (Sultana. *et al*., 2011). The variety NRCHB-101 requires less days to reach 50% blooming, taking only 61 days. With 78 days, the cultivar LOCAL (Assam) takes the longest days to reach 50% blooming. Different genotype may be responsible for the large variance in 50% flowering (Thakur, T. *et al*., 2020). Significantly, the variety SURBHI

takes less number of days to maturity with 106 days. While the variety LOCAL (Meghalaya) and LOCAL (Assam) took more number of days for maturity with 126 days.

Yield attributes were presented in the Table 2 and also depicted in Fig. 2. The number of siliqua plant^{-1} differed significantly due to varietal affects. Among the 8 black gram varieties, the highest number of siliqua was recorded in the variety NRCHB-101 with 159 number of siliqua plant^{-1} as compared with the rest of the treatments and the lowest number of siliqua was recorded in the variety PM-26 with 111.50 number of siliqua. The larger quantity of siliqua in the cultivar NRCHB-101 could be attributable to higher plant height during crop growth phases along with adequate nutrient levels. The quantity of siliqua varies between kinds, which could be attributable to genetic differences (Biswas, S. *et al.*, 2019). Siliqua length differed significantly, the highest siliqua length was recorded in the variety NRCHB-101 with 5.1 cm which was statistically at par with the variety LOCAL (Assam) with 5.0 cm and with the variety LOCAL (Meghalaya) with 4.97 cm respectively. With a length of 4.81 cm, the variety PM-26 had the shortest siliqua length. Significant variability in siliqua length among the assessed rapeseed-mustard varieties could be due to genetic variances in growth habits of the rapeseed-mustard types. Number of seeds per plant is very important parameter in yield attributes and the rapeseed-mustard varieties under testing differ significantly in respect of number of seeds per siliqua. The highest number of seed siliqua^{-1} was recorded in the variety BULLET with 13.21 number of seeds which was statistically at par with the variety LOCAL (Assam) with 13.02 and the variety SURBHI with 12.87 respectively. The lowest number of seeds siliqua^{-1} was significantly recorded in the variety PM-26 with 11.75 number of seeds. The variation in the number of seeds siliqua^{-1} observed across the rapeseed-mustard types could be attributable to the photoperiodic response of the rapeseed-mustard to day-length duration. Test weight (1000 Seed weight) of grains differed significantly due to the effects of variety. The highest test weight was recorded in the variety BULLET with 5.29 g which was statistically at par with the variety SURBHI with 5.10 g and with the variety ANMOL with 5.17, respectively. The lowest test weight was recorded in the variety LOCAL (Meghalaya) with 2.95 g of test weight. There was a lot of diversity in the size of the seeds. Differences in seed weight could be attributable to genetic characteristics of the types under investigation. The weight of 1000 seeds varies from variation to variety and species to species, according to (Mondal. *et al*., 1992). Seed yield of different rapeseed-mustard varieties different significantly. The highest seed yield was recorded in the variety NRCHB-101 with 1631.04 kg ha^{-1} which was statistically at par with the variety SURBHI with 1557.11 kg ha^{-1} and with the variety BULLET with 1549.93 kg ha^{-1}, respectively. The lowest seed yield was recorded in the variety LOCAL (Assam) with only 829.57 kg ha^{-1} of seed yield. It's possible that the contribution of cumulative favourable effects of crop characteristics like number of branches plant^{-1}, siliqua plant^{-1}, and seeds siliqua^{-1} to higher yield by different varieties is due to the contribution of cumulative favourable effects of crop characteristics like number of branches plant^{-1}, siliqua plant^{-1}, and seeds siliqua^{-1} to higher yield by different varieties (Helal. *et al*., 2016). When compared to the other varieties in the study, NRCHB-101 has a significantly greater number of siliqua plant^{-1}, number of seeds siliqua^{-1}, and 1000 seed weight. Stover yield of all the treatments differed significantly. The highest stover yield was recorded in the variety NRCHB-101 with 4261.84 kg ha^{-1} which was statistically at par with the variety SURBHI with 3914.84 kg ha^{-1} and with the variety BULLET with 3855.92 kg ha^{-1}, respectively. The lowest stover yield was significantly recorded in the variety PM-27 with 2165.96 kg ha^{-1} of stover yield. Genetic differences in growth habit, dry mater output, and other growth factors, such as plant height, may explain the diversity in stover yield across rapeseed-mustard types. The highest harvest index was recorded in the variety PM-27 with 29.34 % which was statistically at par with the

variety ANMOL with 28.90 % and with the variety PM-26 with 28.50 % respectively. The lowest was significantly recorded in the variety LOCAL (Assam) with 23.56 % of harvest index. The high degree of positive association between biological yield and harvest index of the different rapeseed-mustard varieties can be attributed to the variation in harvest index of the different rapeseed-mustard varieties. Thus, the variety NRCHB-101 with the highest seed yield and stover yield produced the highest harvest index when compared to the other varieties tested. Oil content varied significantly among the varieties. The highest oil content was recorded in the variety BULLET with 41.15 % which was statistically at par with the variety PM-26 with 40.30 % respectively. The lowest was recorded in the variety LOCAL (Assam) with 29.28 % of seed oil content. The oil content of rapeseed varieties was higher than that of mustard varieties. This could be owing to the variety genetic traits. Oil yield varied significantly among the varieties. The highest oil yield was recorded in the variety NRCHB-101 with 442.56 (kg ha^{-1}) which was statistically at par with the variety SURBHI with 427.13 (kg ha^{-1}) respectively. The lowest was recorded in the variety PM-26 with 215.133 (kg ha^{-1}) of seed oil content. Increase in oil yields mainly owed to increase in seed yield. Oil yield is a function of seed yield and oil content, and both of these factors rose when sulphur levels increased.

The data collected regarding the economics on 8 rapeseed-mustard varieties is presented in the Table 3 and also depicted in Fig. 3. The cost of cultivation is found to be almost same for all the treatments. The highest cost of cultivation was recorded in the variety BULLET with a cost of Rs 23,550/ha followed by SURBHI (Rs 23,540/ha) and NRCHB-101 with Rs 23,280. Where the lowest cost of cultivation was recorded in the variety LOCAL (Meghalaya) with Rs 22,780/ha and variety LOCAL (Assam) with Rs 22,850/ha. The gross return among all 8 varieties were reported highest in the variety NRCHB-101 with Rs 75,841/ha followed by SURBHI with Rs 72,400/ha. And the lowest was recorded in the variety LOCAL (Assam) with Rs 38575/ha. Among all the 8 varieties, net return is recorded highest in the variety

NRCHB-101 with Rs 52,561/ha followed by SURBHI with Rs 48860/ha and the lowest was recorded in the variety LOCAL (Assam) with Rs 15,725/ha. Finally, we recorded the B:C ratio in all 8 varieties, some varieties were recorded high and some are low results. The highest benefit cost ratio was recorded under the variety NRCHB-101 with 3.25, followed by SURBHI, BULLET and ANMOL with 3.07 and 2.88 and 2.87. And the lowest was recorded in the variety LOCAL (Assam) with 1.68.

Table 1: Growth attributes and phenological parameters of different rapeseed-mustard varieties

Treatments	Plant height (cm) at harvest	Plant population m^{-2} at harvest	Number of branches $plant^{-1}$ at harvest	Leaf Area Index (LAI) 60 DAS	Crop Growth Rate (g m^{-2} day^{-1})30-60DAS	Relative Growth Rate (g g^{-1} day^{-1}) 30-60DAS	Days to 50% flowering	Days to maturity
V_1 (PM-26)	89.363	19.293	7.037	0.623	2.097	0.039	64.333	114.333
V_2 (PM-27)	89.953	18.883	8.037	0.633	1.870	0.033	65.667	122.000
V_3 (NRCHB-101)	151.770	17.220	13.257	0.633	2.073	0.038	61.667	119.000
V_4 (SURBHI)	132.840	16.110	11.027	0.550	1.717	0.036	64.667	106.667
V_5 (BULLET)	142.953	15.810	12.043	0.623	1.613	0.037	65.667	106.333

V_6 (ANMOL)	140.500	15.733	11.063	0.590	1.657	0.033	68.000	120.000
V_7 (LOCAL-Meghalaya)	119.610	15.810	10.877	0.820	2.087	0.034	72.000	126.000
V_8 (LOCAL-Assam)	113.203	15.770	10.390	0.807	1.967	0.037	78.000	126.000
SE m ±	1.049	0.099	0.211	0.009	0.088	0.001	0.365	0.591
C.D (P=0.05)	3.213	0.303	NS	0.027	NS	0.003	1.117	1.810

Table 2: Yield attributes of different rapeseed-mustard varieties

Treatments	**No. of Siliqua plant^{-1}**	**Siliqua length (cm)**	**No. of seeds siliqua^{-1}**	**Test weight (g)**	**Seed yield (kg ha^{-1})**	**Stover yield (kg ha^{-1})**	**Harvest index (%)**	**Oil content (%)**	**Oil yield (kg ha^{-1})**
V_1 (PM-26)	111.500	4.913	11.753	3.433	867.820	2,176.147	28.507	40.360	215.133
V_2 (PM-27)	113.903	4.813	12.250	3.437	906.140	2,165.960	29.347	38.810	233.233
V_3 (NRCHB-101)	159.620	5.030	13.210	4.490	1,631.043	4,261.840	27.663	37.000	442.567
V_4 (SURBHI)	147.097	4.973	12.873	5.100	1,557.117	3,914.937	28.437	36.350	427.133
V_5 (BULLET)	144.353	5.130	12.097	5.290	1,459.930	3,855.920	27.460	41.153	354.767
V_6 (ANMOL)	149.610	4.890	11.910	5.177	1,449.910	3,568.533	28.900	37.503	384.933
V_7 (LOCAL-Meghalaya)	139.570	4.970	13.027	2.957	869.200	2,731.010	24.130	30.153	286.567
V_8 (LOCAL-Assam)	138.137	4.940	12.813	2.967	829.577	2,685.940	23.567	29.287	284.233
SE m ±	0.560	0.073	0.332	0.080	37.339	44.885	0.544	0.529	13.843
C.D (P=0.05)	1.716	NS	1.016	0.245	114.354	137.464	1.667	1.619	NS

Table 3: Economic analysis of different treatments

Treatments	**Cost of cultivation (Rs ha^{-1})**	**Gross returns (Rs ha^{-1})**	**Net returns (Rs ha^{-1})**	**B:C ratio**
V_1 (PM-26)	22,910	40353.63	17443.63	1.76
V_2 (PM-27)	22,980	42135.51	19155.51	1.83
V_3 (NRCHB-101)	23,280	75841.51	52561.51	3.25
V_4 (SURBHI)	23,540	72400.52	48860.52	3.07
V_5 (BULLET)	23,550	67886.74	44335.74	2.88
V_6 (ANMOL)	23,420	67420.81	44000.81	2.87

V_7 (LOCAL-Meghalaya)	22,780	40417.80	17637.81	1.77
V_8 (LOCAL-Assam)	22,850	38575.00	15725.00	1.68

Conclusion

The variety NRCHB-101 had the best growth characteristics of all the variations, followed by BULLET and ANMOL. In addition, the variety NRCHB-101 had the highest yield qualities, followed by SURBHI, BULLET, and ANMOL. NRCHB-101, SURBHI, BULLET, and ANMOL were found to be suitable cultivars for late seeded conditions in the Jaintia Hills of Meghalaya based on economic yield.

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Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:
Dkhar, K., T. Gohain., Gade, R.R., Leishangthem, M.S. and Norbu, T. "A Study on the Performance of Different Rapeseed-Mustard Varieties under Late Sown Condition of Jaintia Hills of Meghalaya." *Annals of Plant Sciences.*11.1 (2022): pp. 4670-4678.
DOI: http://dx.doi.org/10.21746/aps.2022.11.1.15