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Research Communication

Growth and productivity of rapeseed and mustard cultivars as influenced by microclimatic interventions in Punjab

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ABSTRACT

A field experiment was conducted during *rabi* season 2019–20 at Department of Climate Change and Agricultural Meteorology, Punjab Agricultural University, Ludhiana to study the effect of uni-directional and bi-directional sowing and growth alterations on rapeseed and mustard cultivars. The growth parameters including yield parameters, oil content and chlorophyll content of different rapeseed and mustard cultivars were studied. It has been found that highest biological yield was observed in cultivar GSC-7 under East-West bi-directional planting method and detopping treatment performed better as compared to no detopping treatment. Significantly highest chlorophyll content was observed for GSC-6 cultivar in North-South direction under no detopping treatment.

Key words: Bi-directional sowing, Chlorophyll content, Rapessed, Mustard, Yield

Rapeseed and mustard are the primary oilseed crops of our country, occupying important place next to groundnut in area and production. *Brassica juncea* i.e. Indian mustard is the most important among all ecotypes in India due to its high seed yield and oil content. In present scenario, main challenge for the agricultural scientists is to increase the production of crops without enlarging the acreage of the crops to accomplish the food security. One of the reasonable ways to do the same, is by harvesting the natural resources like solar radiation i.e. photosynthetically active radiation to the maximum extent (Goyal *et al.,* 2018). Mustard is a source-limited plant in which, post flowering photosynthates are not enough to feed all the blossoming flowers, which results in filling of only some pods of the inflorescence, leaving the inflorescence-top siliqua unfilled. These unfilled pods at the inflorescence-top consumes a lot of assimilates but contribute nothing towards the grain yield. So, with removal of this unproductive top portion of the inflorescence, a scope of supplying more assimilates to the basal developing siliqua may arise. This may increase grain yield by increasing the weight of grains (Yeasmin *et al.*, 2014). This experiment was planned to study the effect of microclimatic interventions on growth & productivity of the crop and also chlorophyll content of the crop, which contributes a lot in production of photosynthates for crop growth.

The field experiment was conducted at the Research Farm of Department of Climate Change and Agricultural Meteorology, PAU Ludhiana during *rabi* 2019-20. The experiment was laid out in a split plot design with three replications and 24 treatments (four cultivars: Giriraj, RLC-3, GSC-7 and GSC-6, three planting methods i.e. uni-directional (E-W), uni-directional (N-S) and bi-directional (E-W, N-S) with two growth alterations viz. detopping and no detopping) in a 3.60 × 3.60 m plot size. In bi-directional sowing, sow the crop in both directions at 30 cm row spacing by using half the seed rate and fertilizer in each direction and the remaining half in the other direction. Four cultivars and three planting methods were kept in main plot and growth alterations were kept in sub-plot. Sowing was done on 21st October by adopting kera method by keeping the sowing depth at 4-5 cm under good soil moisture conditions by using seed rate of 1.5 kg/acre. Row to row spacing was kept 30 cm for two cultivars of raya (Giriraj and RLC-3) and 45 cm for two cultivars of gobhi sarson (GSC-7 and GSC-6) and plant to plant spacing of 10 cm is maintained by thinning for both

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raya and gobhi sarson. The growth alteration treatments were applied at 40 DAS by cutting top 2-3 cm terminal portion of the plant (D_1), including one no detopping (D_2) treatment. Nitrogen was applied in the form of urea (46 per cent N) @ 90 kg/acre, phosphorus (P_2O_5) was applied as single superphosphate (16 per cent P_2O_5) @ 75 kg/acre and muriate of potash (60 per cent K_2O) @ 10 kg/acre in the field. Half dose of the urea, full dose of single superphosphate and muriate of potash was applied at the time of sowing and remaining half of the urea was applied at first irrigation. Chlorophyll content of crop leaves was measured as chlorophyll content index by using opti-sciences chlorophyll content meter (CCM-200 plus) at different phenophases of the crop.

Grain yield

Different cultivars under different planting methods and growth alterations showed a significant effect on grain yield at 5% level of significance. Significantly highest grain yield (22.61 q/ha) was recorded in Giriraj cultivar followed by GSC-7 cultivar (21.17 q/ha) and lowest grain yield (15.04 q/ha) was recorded in GSC-6 cultivar with a critical difference of 0.36 q/ha. Among planting methods, significantly highest grain yield (21.52 q/ha) was observed in bi-directional planting method followed by East-West planting method (17.73 q/ha). Significantly lowest grain yield (17.11 q/ha) was observed in North-South planting method with a critical difference of 0.31 q/ha. Jha *et al.* (2015) also observed same results for Pusa Jagannath cultivar. Grain yield was recorded significantly higher in detopping treatment (19.29 q/ha) than no detopping treatment (18.29 q/ha) with a critical difference of 0.28 q/ha. Tadesse *et al.* (2012) also observed an increase in grain yield with topping at 40 DAS.

Stover yield

Significantly highest stover yield (89.35 q/ha) was observed in GSC-7 cultivar followed by Giriraj whereas, significantly lowest stover yield (79.40 q/ha) was observed in RLC-3 cultivar with a critical difference of 1.87 q/ha. Planting methods also showed a significant effect on stover yield. Significantly highest stover yield (86.91 q/ha) was observed when crop was sown in bi-directional method followed by East-West planting method (84.8 q/ha). Lowest stover yield (81.1 q/ha) was observed when crop was sown in North-South planting method with a critical difference of 1.6 q/ha. Among growth alterations significantly higher stover yield (85.1 q/ha) was observed in detopping treatment as compared to no detopping with a critical difference of 0.74 q/ha.

1000-seed weight

The data recorded on 1000-grains weight under different treatments is presented in the Table 4.12. Significantly highest 1000-grains weight (5.00 g) was observed in Giriraj cultivar followed by 'GSC-7' (4.69 g) whereas,

Table 1. Grain yield, stover yield, 1000-seed weight, harvest index and oil content of rapeseed and mustard crop under different treatments during *rabi* 2019–20

Treatment	Grain yield(q/ha)	Stover yield(q/ha)	1000-seed weight (g)	Harvest index(%)	Oil content (%)
			Cultivars		
'Giriraj'	22.61	86.93	5.00	20.69	40.64
'RLC-3'	16.33	79.40	4.18	17.15	38.56
'GSC-7'	21.17	89.35	4.69	19.22	39.43
'GSC-6'	15.04	81.58	3.87	15.62	36.61
SEm±					
CD (P=0.05)	0.36	1.87	0.07	0.29	0.79
			Planting methods		
Unidirectional(E-W)	17.73	84.87	4.44	17.30	38.93
Unidirectional(N-S)	17.11	81.11	4.31	17.38	38.08
Bi-directional	21.52	86.91	4.56	19.83	39.43
SEm±					
CD (P=0.05)	0.31	1.62	0.06	0.25	0.68
			Growth alterations		
Detopping	19.29	85.08	4.66	18.46	39.55
No detopping	18.29	83.51	4.21	17.87	38.07
SEm±					
CD (P=0.05)	0.28	0.74	0.05	0.22	0.42

Table 2. Chlorophyll content index of rapeseed and mustard under different treatments during *rabi* 2019–20.

Treatment	Vegetative stage	50% Flowering	Start of siliqua development	Pod filling stage	Physiological maturity
Cultivars					
'Giriraj'	40.33	49.03	33.34	28.26	18.20
'RLC-3'	26.00	34.70	25.47	22.69	14.40
'GSC-7'	34.67	43.37	32.72	27.54	15.77
'GSC-6'	41.25	49.95	36.03	33.22	20.25
SEm±					
CD (P=0.05)	0.74	0.84	0.45	0.55	0.33
Planting methods					
Unidirectional(E-W)	31.98	40.68	30.71	27.74	14.85
Unidirectional(N-S)	38.00	46.77	34.54	28.45	18.75
Bi-directional	36.64	45.34	30.43	27.60	17.86
SEm±					
CD (p=0.05)	0.64	0.73	0.39	0.48	0.28
Growth alterations					
Detopping	33.26	42.03	31.27	27.83	17.08
No detopping	37.87	46.50	32.51	28.02	17.22
SEm±					
CD (P=0.05)	0.48	0.56	0.47	NS	NS

significantly lowest 1000-seed weight (3.87 gm) was observed in 'GSC-6' cultivar with a critical difference of 0.07 g. Planting methods also showed a significant effect on 1000-grains weight. Significantly highest 1,000-grains weight (4.56 g) was observed when crop was sown in bi-directional planting method followed by east-west planting method (4.44 g). Lowest 1,000-grains weight (4.31 g) was observed when crop was sown in north-south with a critical difference of 0.06 g. Among growth alterations, 1000-grains weight was found significantly higher in detopping treatment (4.66 g) than no detopping treatment (4.21 g) with a critical difference of 0.05 g. This might be due to more translocation of photosynthates towards side branches after detopping. Alam *et al.* (2014) also observed similar results for rapeseed-mustard.

Harvest index

Significantly highest harvest index (20.69 %) was observed in Giriraj cultivar followed by 'GSC-7' (19.22%) whereas, significantly lowest harvest index was observed in 'GSC-6' cultivar (15.62%) with a critical difference of 0.29%. Planting methods also showed a significant effect on harvest index. Significantly highest harvest index (19.83%) was observed when crop was sown in bi-directional method. Significantly lowest harvest index (17.11%) was observed when crop was sown in North-South planting method which was significantly at par with East-West planting method (17.73%) with a critical difference of 0.25%. Jha *et al.* (2015) also observed similar results having non-significant difference between north-south and east-west direction sowings. Among growth alterations, harvest index was observed significantly higher in detopping treatment (18.46 %) than no detopping treatment (17.87%) with a critical difference of 0.22%.

Oil content

Significantly highest oil content (40.64%) was recorded in Giriraj cultivar followed by 'GSC-7' cultivar (39.43%) and significantly lowest oil content (36.61%) recorded in 'GSC-6' cultivar with a critical difference of 0.79%. Among planting methods, significantly highest oil content (39.43%) was observed in bi-directional planting method followed by East-West planting method (38.93%) which was statistically at par with North-South planting method (38.08 %) with a critical difference of 0.68%. Oil content was recorded significantly higher in detopping treatment (39.55%) than no detopping treatment (38.07%) with a critical difference of 0.42%.

Chlorophyll content index

Significantly higher chlorophyll content was observed for 'GSC-6' cultivar at all the stages of the crop while 'RLC-3' cultivar showed significantly lower chlorophyll content. This might be due to higher leaf area of *gobhi sarson* cultivars as compared to raya cultivars. Among planting methods, higher chlorophyll content was found when crop was sown in North-South direction while lowest in East-West sowing direction.

Similarly, significantly lower chlorophyll content was observed in detopping upto start of siliqua development stage due to relatively younger leaves which emerged after detopping of the main branch whereas, in no detopping treatment leaves were of older age and had high chlorophyll content. Tripathi *et al.* (2006) also resulted that detopping decreases the chlorophyll content of leaves in earlier stages of the crop. When the crop approached at pod filling and physiological maturity, the effect of detopping had already vanished since the leaves were grown older in detopping treatment and had become rich in chlorophyll content and the difference become non-significant at these stages. Chongo and McVetty (2001) observed that chlorophyll content increases with leaf age. The chlorophyll content had decreased from 50% flowering to physiological maturity in all the treatments. Tripathi *et al.* (2006) also observed the similar results which showed that chlorophyll values declined from 50% flowering stage to end of pod filling stage.

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