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Influence of planting patterns and weed control treatments on growth and development of transplanted Gobhi Sarson (*Brassica napus* var. *napus*)

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Abstract
The field experiment entitled "Influence of planting patterns and weed control treatments on growth and development of transplanted Gobhi Sarson (*Brassica napus var. napus*)" was carried out during Rabi 2021 at Agronomy farm, Lovely Professional University, Phagwara, Punjab. The experiment consisted of fifteen treatment combinations of three different planting patterns (Flat, one row per bed, two rows per bed) in main plots and five weed control treatments i.e., T1: Pendimethalin @ 0.45 kg/ha, pre-emergence, T2: Straw mulching (5 t/ha), T3: Black plastic mulch, T4: One hand weeding (30 DAT), T5; Unweeded(control) in subplots. The experiment was laid out in Split Plot Design with four replications, size of the experimental plots are 5m×3m. Results showed that significantly less weed population and dry matter accumulation in plastic mulch and all the planting patterns are at par with each other in both weed count (Per sq.m) and weed dry matter (Per sq ft). Incase of growth parameters, minimum plant height was observed in planting pattern of two rows per bed which was significantly lesser when compared to other planting patterns. Among weed control treatments, Plant height was significantly higher in treatments of Pendimethalin @ 0.45 kg/ha and straw mulch when compared to other weed control treatments and these two treatments were at par with each other. Incase of yield parameters, seed yield was observed to be higher in planting pattern of two rows per bed whose value is 17.29 q/ha which was significantly higher than other two planting patterns. Among weed control treatments, straw mulch, plastic mulch and one hand weeding recorded significantly higher yield than control and pre em. application of pendimethalin @ 0.45 kg/ha. However, application of pendimethalin @ 0.45 kg/ha as pre emergence recorded significantly higher yield than unweeded (control) treatment.

Keywords: Planting patterns, weeds, rabi, management, *Brassica napus*

Introduction
Rapeseed- mustard are the third most important edible oilseed crops of the world after soybean and oil palm. The oil content varies from 37 to 49%. It belongs to the family Brassicaceae. The two main *rabi* oil seed crops in India are rapeseed (*Brassica campestris*) and mustard (*Brassica juncea*). Rapeseed and mustard production in India accounts for roughly 18% of the country's total oilseed production, making it one of the leading producer globally**.** Worldwide the total annual production of rapeseed and mustard is 72.1 million metric tonnes (USDA, 2021). After Canada and China, India stands third in the world for rapeseed-mustard output, making up around 11% of the total oil seed production. Among different States of India, the major rapeseed-mustard growing States are Rajasthan (44.97%), Haryana (12.44%), Madhya Pradesh (11.32%), Uttar Pradesh (10.60%), and West Bengal (7.53%) (ICAR-Director of Rapeseed and Mustard Research, 2019 Report). In Punjab, the total area under mustard/rapeseed has increased from 32,000 hectares to 44,000 hectares in 2021 which is an increase of around 37.5 per cent.

Weeds compete for nutrients, light, space, water, and other resources with the crop and critical period is 15 to 40 days for crop weed competition. The average yield loss in rapeseed-mustard was observed to reach 37.7% (Saraswat *et al*. 2003) [29]. However, the All India Coordinated Project on Rapeseed-Mustard reported that mustard yield loss ranges from 18.1% (Ludhiana) and 41.7% (Varanasi) at diverse sites (AICRP-RM 2011). Due to weed competition for nutrients, moisture, light, and space, which has been estimated to be as high as 30-70% (Tewari *et al*., 1998) [30], so weeds are one of the main causes of agricultural production loss. *Chenopodium album, C. murale*, *Phalaris minor, Avena ludoviciana, Poa annua, Rumex dentatus Fumaria parviflora, Melilotus alba, Asphodelus tenuifolius, Lepidium sativum Orobanche sps, Medicago denticulata and Anagallis arvensis* are some of the common weeds

of mustard. There are a variety of techniques that can be used to control weeds successfully and efficiently in the mustard crop. Among these, hand weeding has been quite popular and successful, but high costs of labour and lack of manpower when it is needed makes it uneconomical Herbicides have been found to be effective for controlling both inter- and intra-row weeds. Mulches have smothering effect on weeds by limiting solar light, which decreases weed seed ability to germinate. Thus, an integrated weed management (IWM) approach is essential to control the weeds that emerge in different stages of crop growth.

Planting patterns plays a key function in increasing overall productivity of field crops as it is likely to affect interception, absorption, penetration and utilisation of incoming solar radiation. Planting pattern is another significant agronomic practice, which can be manipulated to attain the maximum production per unit land area. The nitrogen and water use efficiency is improved with bed planting as compared to flat sowing. In general, farmers who intend to raise mustard can choose any method of planting i.e. direct planting or transplanting. Seed and transplanted crops can be raised on beds or on flat surface by keeping same population and these planting patterns have an impact on the yield of mustard. Moreover, uniform crop stand can be maintained with transplanting technique.

Materials and Methods

This study was carried out at the research farm of the Department of Agronomy, Lovely Professional University, Phagwara during the rabi season of 2021-22. It lies in the northern plain zone of Punjab and the farm lies between 31.26º N and 75.70ºE. The soil of the farm is covered by alluvial soil. Samples of the soil were collected before the conduct of experiment from research area. Soil chemical properties include (pH 8.7), EC (0.15 ds/m), Organic carbon (0.35%), available (N=386.7) kg/ha, available (P=23.2) kg/ha, available (K=226) kg/ha. The experiment consisted of fifteen treatment combinations of three different planting patterns (flat, one row per bed, two rows per bed) in main plots and five weed control treatments i.e., T1: Pendimethalin @0.45 kg/ha, pre-emergence,T2: Straw mulching (5t/ha),T3: Black plastic mulch,T4:One hand weeding(30DAT), T5; Unweeded(control) in subplots. The experiment was laid out in Split Plot Design with four replications, size of the experimental plots are 5m×3m. Variety used in the experiment was PGSH1707 and the spacings followed are 45 cm×15 cm (flat method) and plant population was kept uniform in all planting patterns. After harvesting the previous crop, field was prepared by cultivating twice followed by planking, after that SSP was broadcasted and layout was done with proper water channels.

Raised beds were prepared at 67.5 cm spacings with 37.5 cm bed top and 30 cm furrow with the help of spade. As per the treatments, pendimethalin was sprayed @ 0.45 kg/ha by mixing it with 500 lit/ha of water and straw mulch @5t/ha was spread. Black polythene sheets were spread in subplots according to treatments. Hand weeding was done manually by using khurpa (a small tool) @30 DAT. A quadrat of 30cm×30cm was thrown twice in every subplot randomly and noted the count of weeds at 30,60,90 DAT and at harvest. Weed dry matter was recorded at 30,60,90 DAT and at harvest with a quadrat of 30cm×30cm in every subplot. After oven drying, their dry weight is measured. Harvesting was done with the help of sickles and middle 2 rows were harvested and the samples are kept for drying and net plot size of 4.8 m is harvested in flat method of transplanting and 4.0 m is harvested in bed planting pattern with one row and two rows.

Results and Discussion

Weed parameters

Weed count

At 30 DAS all the planting patterns recorded the similar weed density and they are at par with each other (Table 1). Among weed control treatments, maximum weed population was recorded in unweeded (control) treatment, and lowest weed density is recorded in plastic mulch. Remaining three treatments which are pendimethalin @0.45 kg/ha, straw mulch and one hand weeding recorded the similar weed density and are at par with each other.

At harvest, significantly higher weed density was observed in two rows per bed than flat sowing and the treatments of one and two rows were at par with each other Among weed control treatments, significantly more weed density was recorded in un weeded (control) treatment than all other treatments. However, lowest weed density was observed in plastic mulch which was significantly less than all other weed control treatments.

Weed dry matter

At 30 days, all the planting patterns recorded the similar weed density and they are at par with each other (Table 1). Among weed control treatments, maximum weed population was recorded in unweeded (control) treatment, and lowest weed density is recorded in plastic mulch. Remaining three treatments which are pendimethalin @0.45 kg/ha, straw mulch and one hand weeding recorded the similar weed density and are at par with each other.

At harvest, significantly higher weed density was observed in two rows per bed than flat sowing and the treatments of one and two rows were at par with each other Among weed control treatments, significantly more weed density was recorded in un weeded (control) treatment than all other treatments. However, lowest weed density was observed in plastic mulch which was significantly less than all other weed control treatments.

Table 1: Weed count and weed dry matter as influenced by planting patterns and weed control treatments

Treatments	Weed count		Weed dry matter	
	30 DAT	Harvest	30 DAT	Harvest
Main plot treatments				
M1-Transplanting on flat bed	20.65	44.8	3.81	11.07
M2-one row per bed	19.6	50.05	3.63	12.4
M3-two rows per bed	22.05	56.3	3.69	13.6
CD at 5%	NS	6.65	0.09	1.93
Sub plot treatments				
T1-Pendi@0.45kg/ha	19.25	51.1	3.84	14.45
T2-Straw mulch	17.67	35	4.2	10.87
T3-Plastic mulch	1.05	5.95	0.04	3.08
T4-one hand weeding	22.05	51.8	4.05	11.6
T5-unweeded(control)	44.1	108.5	6.45	21.7
CD at 5%	5.49	6.3	0.31	1.69

Growth parameters

The plant height in transplanting on flat bed was 159.5 cm which was significantly higher than planting pattern of two

rows per bed whose value is 150.0 cm and on par with one row per bed (Table 2). Minimum plant height was observed in planting pattern of two rows per bed which was significantly lesser when compared to other planting patterns. Similar results were also found by Sharma *et al*., (2006) [27]. Among weed control treatments, Plant height was significantly higher in treatments of pendimethalin @ 0.45 kg/ha and straw mulch when compared to other weed control treatments and these two treatments were at par with each other. Bijarnia and Yadav (2017) [31] also found similar results.

The number of leaves per plant in transplanting on flat bed was 32.0 which was significantly higher than planting pattern of two rows per bed which was having a value of 27 and it being at par with one row per bed (Table 2). Planting pattern of two rows per bed recorded significantly lowest number of leaves as compared to other planting patterns. Rajput (2006) [32] found the similar results. Among weed control treatments, number of leaves were significantly higher in treatments of pendimethalin @ 0.45 kg/ha, straw mulch, one hand weeding as compared to unweeded (control) treatment and the above three treatments are at par with each other. Kumar *et al*., (2021) found the similar results.

The crop dry matter in planting pattern of two rows per bed was 82.3 g/plant which was significantly higher than transplanting on flat bed whose value is 74.8 g/plant and it is on par with planting pattern of one row per bed (Table 2). Vandana (2022) [33] reported the same results in dry matter accumulation. Among weed control treatments, pre emergence pendimethalin @ 0.45 kg/ha, straw mulch, plastic mulch, one hand weeding recorded statistically at par dry matter/plant and were significantly higher when compared to unweeded (control) treatment. Waghmode *et al*., (2022) [17] got the same results.

Table 2: Plant height, Number of leaves/plant and crop dry matter as influenced by planting patterns and weed control treatments

Treatments	Plant height(cm)	Number of leaves/ plant	Crop dry matter (g/plant)
Main plot treatments			
M1-Transplanting on flat bed	159.5	32.0	74.8
M2-one row per bed	154.7	30.6	79.4
M3-two rows per bed	150.0	27.0	82.3
CD at 5%	5.3	2.1	3.6
Sub plot treatments			
T1-Pendi@0.45kg/ha	163.4	32.4	80.9
T2-Straw mulch	159.5	31.2	80.0
T3-Plastic mulch	150.6	29.4	80.8
T4-one hand weeding	156	30.6	80.0
T5-unweeded(control)	149.6	25.6	72.6
CD at 5%	5.5	2.2	2.5

Yield attributes

The length of siliqua in transplanting on flat bed (4.0 cm) was significantly higher than planting patterns of one row per bed and two rows per bed and both bed planting treatments were at par with each other (Table 3). Similar results were also found by Sharma *et al*., (2006) [27]. Among weed control treatments, all the treatments including pendimethalin @ 0.45 kg/ha, straw mulch and one hand weeding showed significantly more length. The former treatments were found at with control treatment and are at par with each other.

Number of siliquae in two rows per bed whose value is (455) were significantly higher than other planting patterns and the lowest number of siliquae were observed in the planting pattern of transplanting on flat bed (Table 3). Singh *et al*., (2019) [34] reported the similar results. Among weed control treatments, the treatments of straw mulch, plastic mulch, one hand weeding recorded significantly highest number of siliquae than unweeded (control) and were at par with each other pendimethalin @ 0.45 kg/ha recorded number of siliquae at par with control.

Seed yield which is one of the important attribute yield was observed to be higher in planting pattern of two rows per bed whose value is 17.29 q/ha which was significantly higher than other two planting patterns (Table 3). Lowest seed yield is recorded in planting pattern of transplanting on flat bed. Singh *et al*., (2019) [34] found the similar results. Among weed control treatments, straw mulch, plastic mulch and one hand weeding recorded significantly higher yield than control and pre em. application of pendimethalin @0.45 kg/ha. However, application of pendimethalin @0.45 kg/ha as pre emergence recorded significantly higher yield than unweeded (control) treatment.

Table 3: Length of siliquae, Number of siliquae /plant, seed yield (q/ha) as influenced by planting patterns and weed control treatments

Treatments	Length of siliquae/plant	Number of siliquae/plant	Seed yield (q/ha)
Main plot treatments			
M1-Transplanting on flat bed	4.0	366.0	10.86
M2-one row per bed	3.7	387.8	16.86
M3-two rows per bed	3.7	454.5	17.29
CD at 5%	0.1	18.1	0.4
Sub plot treatments			
T1-Pendi@0.45kg/ha	3.8	369.6	14.17
T2-Straw mulch	3.8	464.1	15.87
T3-Plastic mulch	3.9	460.2	15.13
T4-one hand weeding	3.7	461.0	15.74
T5-unweeded (control)	3.8	357.8	13.26
CD at 5%	NS	17.2	0.62

Conclusion

From the experimental results, it can be concluded that in *Brassica napus* seed yield can be improved by following planting pattern among weed control treatments, straw mulch, plastic mulch and one hand weeding recorded significantly higher yield than control and pre em. application of pendimethalin @0.45 kg/ha.

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