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Performance of transplanted Gobhi Sarson (*Brassica napus var. napus*) in relation to nitrogen levels and weed control treatments

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Abstract
A field experiment entitled "Performance of transplanted Gobhi Sarson (*Brassica napus var. napus*) in relation to nitrogen levels and weed control treatments" was conducted at the experimental farm of School of Agriculture, Lovely Professional University, Phagwara. Experiment was laid out in Split Plot Design with four N levels (0, 75,100,125kg N/ha) in main plots and four weed control treatments i.e. plastic mulch, straw mulch, hand weeding, control in subplots. The crop gave significantly higher plant height (160.7 cm), plant dry matter (85.08 gm/plant), chlorophyll index (65.8), length of silique (5.67 cm), seed yield (18.81 q/ha), stover yield (9.75 q/ha) and oil yield (724.7 kg/ha) with the application of 125 kg N/ha as compared to other nitrogen levels. Application of 125 kg N/ha, 100 kg N/ha and 75 kg N/ha increased seed yield of Gobhi Sarson by 110.6,91.5 and 72.0% than in un weeded control respectively. In weed control treatments plastic-mulch proved significantly better for weed control, increased growth and yield attributes than straw mulch and one hand weeding treatments. Application of plastic mulch, paddy straw mulch and one hand weeding increased seed yield by 146.3,97.6,129.3 percent than the control respectively.

Keywords: Nitrogen, growth, development, plastic-mulch and paddy straw mulch

Introduction
Oil seed crop are like cereals, have a vital role in the Indian economy. Rapeseed and mustard belong to the Cruciferae family, it is the most important *rabi* oil seed crop. In India there are seven edible oilseed crops (groundnut, rapeseed and mustard, soybean, sunflower, niger, sesamum, and safflower) and two non-edible oilseed crops (linseed and castor) which boost the Indian agricultural economy. The total area under oil seeds crop in India was 101.47 lakh ha (Press Information Bureau, 2022-2023). Rapeseed & mustard is the first domesticated crop among the other oil seed crop and also most important crop after Soyabean & Groundnut. Rapeseed-mustard are grown in the majority of States of the country, the majority of production comes from Rajasthan (44.97%), Haryana (12.44%), Madhya Pradesh (11.32%), Uttar Pradesh (10.60%), and West Bengal (7.53%) throughout the growing season (2014-15 to 2018-19), (Anonymous 2019) [2]. Total cultivated area, production and productivity in India under Rape seed & Mustard was 6856.27 (000 ha), 9123.64 (000 tones), 1331 kg/ha respectively. The area under rapeseed-mustard in Punjab State was 54,000ha with average productivity of 1,558 kg/ha (Indiastat, 2020). The oilseed crop has been incorporated as an essential part of both the human and animal diets due to the nutritious content of its byproducts. Oilseeds are beneficial for human health due to their high levels of amino acids, proteins, and fat reserves (Abiodun, 2017) [4].

Gobhi sarson (*Brassica napus*), a newly developed oilseed crop with a small cultivable area only confined to Haryana, Punjab and Himachal Pradesh, it is the most significant oilseed in India and comes in second place after groundnut in terms of economic importance. *Brassica campestris* (var. toria, yellow Sarson, and brown Sarson), *Brassica juncea* L. (Indian mustard), *Brassica napus* L. (Gobhi Sarson and canola), and *Brassica carinata* A. Br. (African sarson) are the four subspecies of rapeseed and mustard, in addition to *Eruca sativa* (Taramira). *Brassica napus* (Gobhi sarson) is an amphiploid between *Brassica Campestris* (var. toria, yellow sarson, and brown sarson) and *Brassica oleracea* (wild mustard). It contains higher oil content (41-45%) of good quality. Having high recovery of essential fatty acids i.e., oleic acid, linoleic acid.

One crucial element for improving the growth, production, and quality aspects of a crop is fertiliser. Poor soil fertility, particularly in sandy loam soils, is a significant barrier to the production of mustard. Nitrogen is one of the plant nutrients that is invariably inadequate in Indian soils. Since it regulates the protein content and crop production, nitrogen is the most crucial nutrient for mustard crop development and productivity. By influencing various growth parameters and resulting in more vigorous growth and development, nitrogen increases yield. This is evidenced by an increase in plant height, the number of flowering branches, total plant weight, leaf area index, and the number and weight of siliquae and seeds produced per plant.

The main component affecting mustard productivity is weed plant infestation. The severity and kind of weeds that are infesting the crop may affect the quantity lost. The Gobhi Sarson crop is extremely vulnerable to weed competition, especially in the first 20 to 40 days after sowing. Weeds cause yield losses ranging from 30-50%. The extent of losses to crop may depend upon the intensity and type of infesting the crop. The mechanical method or the use of mulches (plastic and straw) or the use of herbicides, or a combination of any two ways can be used to manage weeds in transplanted Gobhi sarson (IWM). Mulches (straw or plastic) perform a very significant role in the soil by adding organic matter (straw only), conserving soil moisture, suppressing weed growth and regulating soil temperature.

Materials and Methods

A field experiment was conducted during the *rabi* season of 2021-2022 at the experimental farm of Department of Agronomy, School of Agriculture, Lovely Professional University, Jalandhar, Punjab to study the performance of transplanted Gobhi Sarson (*Brassica napus var. napus*) in relation to nitrogen levels and weed control treatments. The overall experiment was laid out in Split Plot Design (SPD) with 4 Nitrogen levels and 4 weed-control methods. The experiment was conducted in 4 replications with 64 plots; Treatments comprising of *viz*., Nitrogen levels (N_1= 0 kg N ha^{-1}, N_2= 75 kg N ha^{-1}, N_3= 100 kg N ha^{-1}, N_4= 125 kg N ha^{-1}) in the main plot and weed control treatments T_1= straw mulch (5 t/ha), T_2= plastic mulch (black), T_3= one hand weeding at 30 DAT, T_4= un weeded) in sub-plots. The soil sample from 0-15 cm & 15-30 cm depth of the soil were taken from the experimental plot before sowing to identify the current fertility status of the experimental site. The soil of experimental site was sandy loam in texture with pH (8.65), EC (0.489 dsm^{-1}), OC (0.28%), available N (225 kg ha^{-1}), available P (9.48 kg ha^{-1}) and available K (160 kg ha^{-1}). The variety used for this experiment was PGSH 1707; Firstly, nursery was raised one month prior to transplanting. Transplanting was done on November 18, with a spacing of 45 cm in rows and 10 cm between the plants was maintained. Black polythene (15µm) sheets was spread in sub plots according to treatments and holes were made to facilitate transplanting of the crop. Straw mulch @ 5t/ha was spread out in the field after the transplanting was done in accordance with treatments. The different levels of N were applied in accordance with the treatments. Total 3-irrigations were given during the crop-period i.e., one irrigation immediately after the transplanting, next irrigation after 30days and last irrigation was given at crop flowering time. One hand weeding was performed at 30 DAT in hand weeding treatment weed count and dry matter was recorded from a quadrat of 1sq.ft. from two places per plot randomly. Observation on growth was recorded from 5 randomly selected plants from each plot i.e., plant height, dry matter accumulation, chlorophyll index by SPAD at harvesting. The data for yield attributes i.e., no. of silique/plant, length of silique (cm), no. of seeds/silique, 1000-grain weight (gms), straw yield (kg/ha) were recorded at harvesting time. The data was analyzed through OPISTAT, HAU.

Results and Discussion

Weed count/sq.m

Nitrogen levels and weed control treatments had a significant impact on the weed count that was recoded at harvest time (Table 1). In comparison to all other nitrogen levels, the weed count (per sq. m) at 125 kg N/ha was significantly less than all other nitrogen levels. In terms of the number of weeds per square metre, the weed count in 0 kg N/ha was at par with 100 kg N/ha, and both of these treatments recorded higher than 75 kg N/ha. Weed population/sq. m was significantly higher in the unweeded (control) than all other weed control treatments. Paddy straw mulch and one hand weeding recorded significantly more weeds per sq. m. than plastic mulch. Additionally, paddy straw mulch significantly reduced the number of weeds compared to one hand weeding treatment. Less weed count in higher level of nitrogen i.e., 125 kg N/ha may be due to more smothering effect of crop on weed. Plastic mulch provided very effective control of weeds up to harvest of crop which may be due to better soil cover which did not allowed weed seeds to germinate and it was followed by paddy straw mulch.

Weed dry matter (q/ha)

The various nitrogen levels and weed management methods had a considerable impact on weed dry matter at harvest (Table 1). Maximum weed dry matter accumulation was recorded with the 0 kg N/ha, which was significantly more than 75, 100, and 125 kg N/ha and all the later nitrogen levels were found to be at par with one another. The unweeded (control) treatment had the significantly higher weed dry matter (q/ha) than all other weed control treatments plastic mulch recorded significantly less dry matter of weeds than straw mulch and one hand weeding.

Weed control efficiency

Weed control efficiency was high (54.54%) in 125 kg N/ha and it was lowest (44.27%) in 0kg N/ha (Table 1). Among Weed control treatments, plastic mulch showed highest (94.05%) weed control efficiency which was followed by paddy straw (51.89%) and one hand weeding (41.08%) treatment.

Table 1: Effect of nitrogen levels and weed control treatments on weed count (per 1 sq. m), weed dry matter (q/ha) and Weed control efficiency (%)

Treatments	Weed count (per sq. m)	Weed dry matter (q/ha)	Weed control efficiency (%)
Main plot-Nitrogen levels			
N_1-0 kg N/ha	44.62 (180)	2.68 (10.3)	44.27
N_1-75 kg N/ha	40.84 (150)	2.54 (9.8)	47.02
N_1-100 kg N/ha	43.17 (166)	2.60 (9.9)	46.48
N_1-125 kg N/ha	32.96 (99)	2.47 (8.4)	54.54
CD at 5%	2.96	0.15	
Subplots -Weed control treatments			
T1-Paddy straw	38.73 (110)	3.3 (8.9)	51.89
T2-Plastic mulch (black)	1.1 (0)	0 (1.1)	94.05
T3- One hand weeding	46.39 (180)	2.14 (10.9)	41.08
T4-Unweeded(control)	59.49 (310)	3.96 (18.5)	0
CD at 5%	2.56	0.12	
C.D for interaction	NS	NS	NS

Plant height (cm)

Plant height at harvest in 0 kg, 75 kg, and 100 kg N/ha was significantly more than 125 kg N/ha (Table 2). significantly less plant height was recorded in 0 kg N/ha than all other nitrogen levels. Among weed control methods, the unweeded treatment had the significantly low plant height (93.5 cm). Higher nitrogen levels, especially 125 kg N/ha and 100 kg N/ha, increased plant height due to better plant growth. Crop growth was better in plastic and straw mulch which may be due to better weed control. Similar results were reported by Gill *et al.*, (2022) [5], Kaur *et al.*, (2022) [7].

Plant dry matter (gm/plant)

Plant dry matter at harvest was significantly more with the application of 125 kg/ha than 0 kg, 75 kg, and 100 kg N/ha (Table 2). It was determined that there was no significant difference between 0 kg N/ha, 75 kg N/ha, and 100 kg N/ha for dry matter per plant. Plant dry matter in paddy straw mulch, plastic mulch, and one-handed weeding was found at par with each other. The unweeded treatment recorded significantly less crop dry matter (78.9 gms), than all other weed control treatments. Crops grown at higher nitrogen levels was more than that of lower levels. Similarly, straw mulch, plastic mulch, and one handed weeding treatments substantially reduced weed growth, and hence more crop plant dry matter was noted. Kaur *et al.*, (2022) [7] find the similar results.

Chlorophyll index

Chlorophyll index recorded 90 DAT was substantially higher (65.8) when 125 kg N/ha of nitrogen was applied as compared to other nitrogen levels (Table 2). 0 kg N/ha had a considerably lower chlorophyll index than all other nitrogen level treatments. Application of 75 kg and 100 kg N/ha nitrogen was found to be at par. It was determined that there was no significant variation in chlorophyll index between the sub plot treatments. However, one hand weeding treatment revealed its numerically higher values. Similar results were found with Singh *et al* (2019) [14].

Table 2: Effect of nitrogen levels and weed control methods on periodic plant height (cm), plant dry matter (gm/plant), chlorophyll index of leaves by SPAD meter

Treatments	Plant height (cm)	Plant dry matter (gm/plant)	Chlorophyll index of leaves by SPAD meter
Main plot- Nitrogen levels			
N_1-0 kg N/ha	96.5	82.84	58.1
N_1-75 kg N/ha	108.0	81.97	62.0
N_1-100 kg N/ha	151.3	80.77	60.9
N_1-125 kg N/ha	160.7	85.08	65.8
CD at 5%	3.35	2.99	2.10
Sub plots- Weed control treatments			
T1-Paddy straw	141.4	84.33	61.4
T2-Plastic mulch(black)	141.7	83.54	60.7
T3- One hand weeding	140.0	83.87	63.8
T4-Unweeded(control)	93.5	20.85	60.9
CD at 5%	2.90	1.98	NS
C.D interaction	NS	NS	NS

Length of silique per plant (cm)

Application of 125 kg N/ha, recorded significantly more length of silique per plant than that of the other treatments (0, 75, and 100 kg N/ha) (Table 3). It was determined that the differences between N0 and N75 kg/ha were non-significant. Silique was found to be much longer in 100 kg N/ha than in 75 kg N/ha and differences were significant. One handed weeding produced the longest length of silique (5.15 cm), followed by plastic mulch (5.14 cm), and paddy straw mulch (5.02 cm), all of these being at par and significantly more than unweeded (control) treatment. Similar results were identified with Kaur *et al.*, (2022) [7] and Singh *et al* (2019) [14].

Seed yield (q/ha)

Compared to all other nitrogen levels, the application of 125 kg N/ha resulted in significantly increase in seed yield (18.81 q/ha) (Table 3). With each increase in nitrogen level from 0 kg - 75 kg - 100 kg - 125 kg N/ha, there was substantial

increase in seed yield. Application of 125 kg N/ha, 100 kg N/ha, and 75 kg N/ha improves seed production by 110.6, 91.5, and 72.2 percentage respectively as compared to 0 kg N/ha. Less weed density, better growth characteristics, and better yield characteristics may be responsible for the higher seed production in 100 kg N/ha and 125 kg N/ha. The sub-plot treatments with highest seed yield was recorded in plastic mulch (19.19 q/ha), manual weeding (17.86 q/ha), and paddy straw mulch (15.39 q/ha), which was significantly more than unweeded control treatment (7.79 q/ha). One handed weeding produced significantly more seed yield than mulching with straw. The unweeded control produced significantly less seed yield than all other treatments. Plastic mulch, one handed weeding, and straw mulch increased seed yield in unweeded control by 146.3, 129.3, and 97.6 percentage respectively than better weed control, better growth characteristics, and better yield characteristics may all contribute to higher yield with plastic mulch. Similar results were identified with Shergill *et al*. (2012) [16], Kardgara *et al*. (2010) [9] and Mondal *et al*. (2008).

Stover yield (q/ha)

In comparison to all levels of nitrogen, the stover yield was significantly less in 0 kg N/ha (Table 3). However, the stover yield increased significantly with each increment in nitrogen dose, from 0 kg - 75 kg - 100 kg - 125 kg N/ha. In comparison to all other treatments, the unweeded (control) treatment reported significantly low stover yield. Application of plastic mulch, one-handed weeding, and paddy straw mulch increased stover yield significantly than control. Rajput (2012) [11] and Shergill *et al*. (2012) [16] also found similar results.

Table 3: Effect of nitrogen levels and weed control treatments on length of silique per plant (cm), seed yield (q/ha), stover yield (q/ha) and oil yield (kg/ha)

Treatments	Length of silique per plant (cm)	Seed yield (q/ha)	Stover yield (q/ha)	Oil yield (kg/ha)
Main plot- Nitrogen levels				
N_1-0 kg N/ha	4.11	8.93	9.21	337.3
N_1-75 kg N/ha	4.36	15.39	9.39	578.8
N_1-100 kg N/ha	5.03	17.10	9.61	650.9
N_1-125 kg N/ha	5.67	18.81	9.75	724.7
CD at 5%	0.27	1.17	0.08	52.10
Sub plots- Weed control treatments				
T1-Paddy straw	5.02	15.39	10.55	606.2
T2-Plastic mulch(black)	5.14	19.19	9.62	741.5
T3- One hand weeding	5.15	17.86	9.18	670.2
T4-Unweeded(control)	3.86	7.79	8.31	287.4
CD at 5%	0.19	1.25	0.04	38.20
C.D for interaction	NS	NS	NS	NS

Oil yield (kg/ha)

Nitrogen levels and weed management methods have shown significantly effect on oil output (kg/ha) (Table 3). In comparison to all other nitrogen levels, the oil production at 0 kg N/ha was significantly less. The highest oil yield (724.7 kg/ha) was recorded in 125 kg N/ha which was significantly more than 100 kg N/ha (650.9 kg/ha), 75 kg N/ha (578.8kg/ha) and 0 kg N/ha (337.3 kg/ha). Plastic mulch had the greatest oil production (741.5kg/ha), which was significantly more than all other weed control methods. The oil output from one hand weeding (670.2 kg/ha) was significantly higher than that from paddy straw mulch (606.2 kg/ha). Unweeded (control) produced significantly less oil yield than all other treatments.

Nitrogen uptake by crop (kg/ha)

Nitrogen levels and weed control methods had a significant impact on nitrogen uptake by crop (Table 4). Compared to all other nitrogen levels, nitrogen uptake by crop was significantly less 0 kg N/ha. The uptake of nitrogen was found to be at par by 100 kg N/ha (89.7 kg/ha) and 125 kg N/ha (97.1 kg/ha). Unweeded (control) treatment recorded significantly less nitrogen uptake all other treatments (45.7 kg/ha). Paddy straw mulch (105.0 kg/ha) and plastic mulch (106.2 kg/ha) treatments were found at par for N uptake for crop but showed significantly more N uptake than one hand weeding. Higher amounts of nitrogen may result in more nitrogen intake than lower levels due to the accumulation of higher biological yield. The unweeded (control) recorded poor crop due to weed competition and hence this treatment produced less biological yield and less N uptake by crop. Similar results were found with Thakur *et al*. (2005) [17], Rathore and Manohar (1992) [13].

Nitrogen uptake by weeds (kg/ha)

Under 0 kg, 75 kg, and 100 kg N/ha, nitrogen uptake by weeds was found to be equal, and all these nitrogen levels reported significantly more uptake of N than 125 kg N/ha. In sub plot treatments, the unweeded (control) treatment reported significantly more N uptake (35.52 kg/ha) than all other weed control treatments. Straw mulching resulted in significantly less N uptake by weeds than one hand weeding. However, plastic mulch substantially suppressed weed growth, completely and hence N uptake by weeds was zero in this treatment (Table 4).

Table 4: Effect of nitrogen levels and weed control treatments on nitrogen uptake by crop (kg/ha) and nitrogen uptake by weeds (kg/ha)

Treatments	Nitrogen uptake by crop (kg/ha)	Nitrogen uptake by weeds (kg/ha)
Nitrogen levels Main plots		
N_1-0 kg N/ha	63.4	19.38
N_1-75 kg N/ha	75.6	18.52
N_1-100 kg N/ha	89.7	18.91
N_1-125 kg N/ha	97.1	16.06
CD at 5%	10.31	0.91
Weed control treatments-Sub plots		
T1-Paddy straw	105.0	17.0
T2-Plastic mulch(black)	106.2	-
T3- One hand weeding	83.3	20.70
T4-Unweeded(control)	45.7	35.52
CD at 5%	11.22	1.71
C.D for interaction	NS	NS

Conclusion

It can be concluded from the field study that the application of 125 kg N/ha increases the plant height, plant dry matter, chlorophyll content, length of silique, seed yield, stover yield, oil yield, and nitrogen uptake by crop. Among the weed control treatments, plastic-mulch followed by paddy straw mulch-controlled weeds very effectively and improves the growth, yield and quality parameters of Gobhi Sarson. Based on results, it was concluded that application of 125 kg N/ha gave higher yield than other N levels and among sub plots, plastic mulch followed by paddy straw mulch were better than other weed control treatments.

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