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Effect of Phosphorus and Growth Regulators on Gobhi Sarson (*Brassica napus*)

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ABSTRACT

A field experiment was conducted, during *rabi* season of 2020-21 to study the effect of phosphorus and growth regulators on Gobhi Sarson (*Brassica napus*). The experiment was laid out in Factorial Randomized Block Design with 12 treatments and 3 replications. The experiment consisted of four phosphorus levels i.e., 0, 15, 30 and 45 kg P_2O_5 ha^{-1} without and with growth regulators i.e., Salicylic acid at 100 ppm and Naphthalene acetic acid at 40 ppm at 60 and 80 DAS. Application of 45 kg P_2O_5 ha^{-1} + NAA 40 ppm significantly improved plant height, chlorophyll content, leaf area index, dry matter accumulation. Crop growth rate and relative growth rate at 90 DAS and number of primary and secondary branches per plant, number of siliquae $plant^{-1}$, number of seeds $siliquae^{-1}$, siliquae length (cm) and seed yield (q ha^{-1}) at harvest 128 DAS was found.

Keywords Gobhi Sarson, Phosphorus, Growth regulators, Yield.

INTRODUCTION

India has the world's fourth-largest oilseed economy. Among the seven edible oilseeds cultivated in India, rapeseed-mustard accounts for 28.6% of total oilseed production and rapeseed and mustard is India's most important *rabi* oilseed crop, accounting for 27.8% of the country's oilseed economy. The scientific name for Gobhi Sarson is (*Brassica napus*). Gobhi Sarson is a long-duration crop (155 days) found only in Punjab, Himachal Pradesh and Haryana. The states of Rajasthan, Uttar Pradesh, Haryana, Punjab, Madhya Pradesh and Gujarat are the largest producers of mustard in India. Rajasthan has the most rapeseed and mustard area and production, with 2.50 million hectares and 4.08 million tonnes (2017) respectively (Anonymous 2017).

The quality of the oil in rapeseeds and mustard contains a sufficient amount of erucic acid (40-60%), as well as linolenic acid (4.5–13%). Just about 25–30 % of the nutrition is oleic acid and linoleic acid, which have a higher nutritive value (Gautam *et al.* 2020). Calcium, manganese, copper, iron, selenium, zinc, vitamin A, B, C and proteins are all abundant in mustard. Mustard seed has 508 calories per 100 g, 28.1 g of carbohydrates, 26.1 g of protein, 25–35% total fat, and 12.2 g of dietary fiber (Anonymous 2016). The oil content in mustard is about 35–40% and protein content ranges from 25–30%.

Phosphorus is important for improving and maintaining crop productivity all over the world. *Brassica* species have a high phosphorus requirement, according to common perception. Many soils have a significant amount of this nutrient, but not enough to

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Table 1. Effect of phosphorus and growth regulators on plant height and chlorophyll content.

Treatments	Plant height (cm)			Chlorophyll content (SPAD value)		
	30 days	60 days	90 days	30 days	60 days	90 days
Sources						
S_1- without GR	10.7	21.6	126.1	44.1	51.8	46.0
S_2- with GR (Salicylic Acid)	10.1	21.7	130.3	44.6	51.7	56.8
S_3- with GR (Naphthalene Acetic Acid)	10.1	21.3	133.5	45.0	51.9	58.6
CD	NS	NS	3.96	NS	NS	1.60
SE	0.23	0.35	1.35	0.54	0.49	0.54
CV	7.72	5.67	3.60	4.22	3.29	3.50
Levels						
P_1- 0 kg P_2O_5/ha	10.1	20.0	124.11	44.8	49.9	50.3
P_2- 15 kg P_2O_5/ha	10.2	21.0	127.61	43.9	51.2	52.7
P_3- 30 kg P_2O_5/ha	10.4	21.8	131.56	45.6	52.3	55.3
P_4- 45 kg P_2O_5/ha	10.5	23.2	136.56	43.9	53.7	57.1
CD	NS	1.19	4.57	NS	1.67	1.84
SE	0.27	0.41	1.56	0.63	0.57	0.63
CV	7.72	5.67	3.60	4.22	3.29	3.50
Interaction (S*L)						
CD	NS	NS	NS	NS	NS	NS
SE	0.46	0.70	2.70	1.08	0.98	1.09
CV	7.72	5.67	3.60	4.22	3.29	3.50

meet the needs of the rapeseed and mustard crop due to low temperature during initial growth period the residual P availability is low. Phosphorus fertilizer has impact on yield, even less than nitrogen, but noticeably more than Potassium. Phosphorus is an essential component of plant metabolism since it aids in cellular energy transfer, respiration and photosynthesis. It increases oil content, seed size and stimulates seed filling. As a component of nucleoproteins and nucleotides, it participates in metabolic activities and is involved in the formation of energy-rich bonds such as adenosine diphosphate (ADP) and adenosine triphosphate (ATP) (Solanki *et al.* 2016). Phosphorus is generally deficient in the majority of our Indian soils and needs much attention for maintenance of soil fertility. Sufficient P gets a hard start right from the seedling stage, produces deeper and proliferous roots which enable it to feed on a bigger soil volume for water and nutrients.

Plant hormones are developed naturally by the plants and are essential for their growth regulation. When applied as a foliar spray at the proper crop growth stage in optimum concentration, PGRs that boost plant physiological efficiencies could play a significant role inincreasing crop yield and quality (Garai and Datta 2003). Salicylic acid (SA) is a phenolic phytohormone that plays a role in plant growth and development, photosynthesis, transpiration, ion uptake and transport, among other things. SA a powerful signalling molecule in plants, plays a role in defensive mechanisms by controlling physiological and biochemical functions, as well as having a variety of effects on biotic and abiotic stress tolerance (Muthulakshmi and Lingakumar 2017). Naphthalene acetic acid (NAA) is a commonly used synthetic auxin in plants. Auxin encourages cell elongation, or expansion, at low concentrations, but inhibits growth at higher concentrations (Chute *et al.* 2017). Auxins affect plants and their other growth regulators in a number of ways. Different plants have shown different effects of NAA application in terms of rooting speed, flower power, fruit setting ratio,

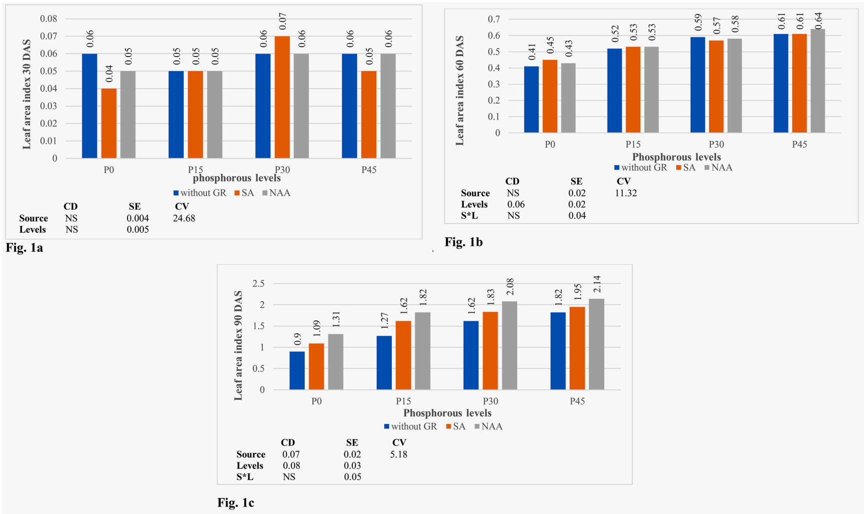


Fig. 1a. Effect of phosphorus and growth regulators on leaf area index at 30 DAS. **Fig. 1b.** Effect of phosphorus and growth regulators on leaf area index at 60 DAS. **Fig. 1c.** Effect of phosphorus and growth regulators on leaf area index at 90 DAS.

fruit drop prevention and fruit formation (Prakash and Ganesan 2001).

MATERIALS AND METHODS

A field experiment was conducted during winter (*rabi*) season of 2020-21 at Lovely Professional University Phagwara Research Farm, which is located at 31°15'N, 75°42' E and 235 m above mean sea level in Punjab. The variety of rapeseed-mustard was HYOLA PAC 401. The recommended dose of fertilizer 100 : 30 : 0 kg /ha (N : P : K) in the form of urea, DAP was applied to the soil as 50% N and 100% P basal dose and the remaining 50% N applied at 30 DAS. The land is ploughed 2 times to make free from weeds, clods after ploughing land are leveled 26 November 2020. The sowing was done on 27th, Nov 2020 line sowing was done with row to row spacing of 30 cm and depth is 3–5 cm. The irrigation was given whenever necessary. The recommended cultural operations and plant protection measures were carried out timely. The foliar sprays of PGR's Salicylic acid 100 ppm and Naphthalene acetic acid 40 ppm were given at the time of 60 and 80 DAS. The experiment was laid out in a Factorial Randomized Block Design with three replications having plot size 5 × 3 m^2. Twelve treatment combinations comprising T_1 @ 0 P kg ha^{-1} + 0 GR, T_2 @ 15 P kg ha^{-1} + 0 GR, T_3 @ 30 P kg ha^{-1} + 0 GR, T_4 @ 45 P kg ha^{-1} + 0 GR, T_5 @ 0 P kg ha^{-1} + SA 100 ppm, T_6 @ 15 P kg ha^{-1} + SA 100 ppm, T_7 @ 30 P kg ha^{-1} + SA 100 ppm, T_8 @ 45 P kg ha^{-1} + SA 100 ppm, T_9 @ 0 P kg ha^{-1} + NAA 40 ppm, T_{10} @ 15 P kg ha^{-1} + NAA 40 ppm, T_{11} @ 30 P kg ha^{-1} + NAA 40 ppm, T_{12} @45 P kg ha^{-1} + NAA 40 ppm.

The soil at the experimental site was loamy sand- clay % 4.08, silt % 11.22 and sand % 84.7, neutral in pH of 7.2 and EC =1.07 ds/m with an initial fertility status of medium-range in available nitrogen 295 kg ha^{-1}, low range in available phosphorus 18.46 kg ha^{-1} P_2O_5, medium-range in available potassium 180 kg ha^{-1} K, low range in organic carbon is 0.285% and finally, organic matter is 0.491%.

Soil texture determined by mechanical analysis using the pipette method, pH of the soil was determined with the help of digital pH meter, EC of soil is analyzed with an electrical conductivity meter (Jackson 1967), Organic carbon was determined by Walkley and Black's titration method, Available nitrogen estimated by Kjeldhal's procedure (Subbiah and Asija 1956), Available phosphorus estimated by Olsen's method (Olsen *et al.* 1954), Available

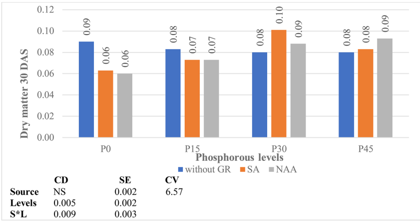


Fig. 2a

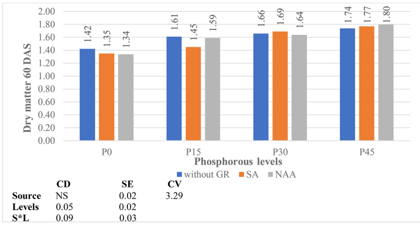


Fig. 2b

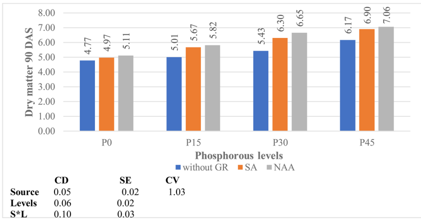


Fig. 2c

Fig. 2a. Effect of phosphorus and growth regulators on dry matter (t/ha) at 30 DAS. **Fig. 2b.** Effect of phosphorus and growth regulators on dry matter (t/ha) at 60 DAS. **Fig. 2c.** Effect of phosphorus and growth regulators on dry matter (t/ha) at 90 DAS.

potassium estimated by Flame Photometer (Toth and Prince 1949).

The observations were recorded as per the 5 plants were selected randomly in each net plot. Plant growth parameters like plant height, chlorophyll content, leaf area index, dry matter accumulation, crop growth rate, relative growth rate, primary branches, secondary branches and yield parameters like number of siliquae per plant, length of siliquae, number of seeds per siliquae and seed yield.

Crop growth rate : CGR was calculated using the below formulae.

$$CGR= (W_2–W_1)/t_2\text{-}t_1 \text{ g m}^2 \text{ day}^1$$

Relative growth rate : RGR was calculated using the below formulae.

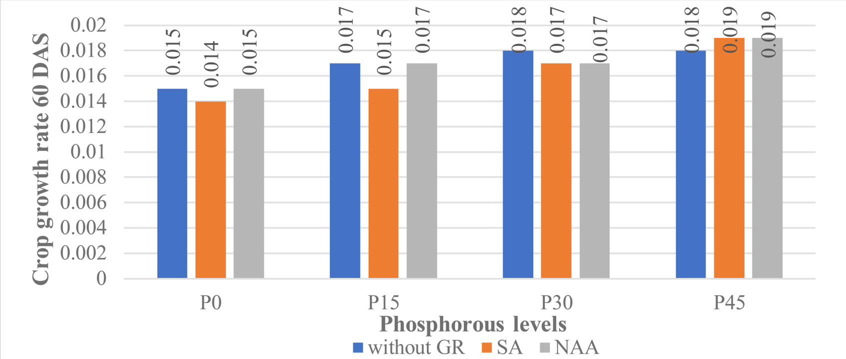
$$RGR = (\log e\ W_2–\log e\ W_1)/t_2–t_1$$

RESULTS AND DISCUSSION

The effect of phosphorus on plant height and chlorophyll content was non-significant at 30 DAS due to *Brassica napus* seedlings started to emerging 7 to10 days after sowing (Table 1). The growth parameters of Gobhi Sarson were significantly affected by increasing the levels of phosphorus. Application of phosphorus @ 45 kg P_2O_5 ha^{-1} showed significantly increased plant height and chlorophyll content at 60 DAS followed by 30 kg $P_2 O_5$ ha^{-1} (Table 1). At the stage of 60 and 80 DAS two times sprayed growth regulators NAA and SA, it showed significantly increased plant height and chlorophyll content in PGR's source and Phosphorus levels at 90 DAS. Application of 45 kg P_2O_5 ha^{-1} with NAA 40 ppm observed higher plant height and chlorophyll content followed by 45 kg P_2O_5 ha^{-1} with SA 100 ppm (Table 1). These findings are consonance with Potdar *et al*. (2019), Prasanth *et al.* (2018). Application of phosphorus increase the plant height through cell elongation cell division photosynthesis and turbidity of plant cell. The photosynthetic activities of green plants are directly influenced by the chlorophyll content of leaves. The NAA level significantly influenced the chlorophyll a and b content in leaf.

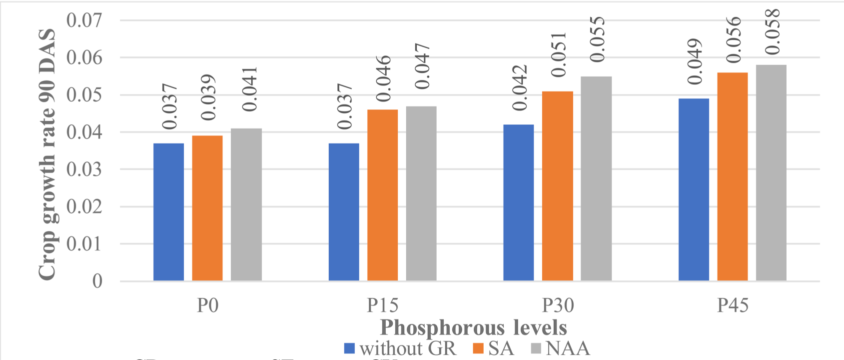
Effect of phosphorus and growth regulators on leaf area index at 30, 60, 90 DAS

The data from Fig.1. (a, b, c) indicates that increasing the phosphorus levels and growth regulators (S*L) had no significant effect on leaf area index at 30, 60 and 90 DAS. At 60 DAS leaf area index shows sig-



	CD	SE	CV
Source	NS	0.0006	12.47
Levels	0.002	0.0007	
S*L	NS	0.001	

Fig. 3a.



	CD	SE	CV
Source	0.002	0.0006	4.43
Levels	0.002	0.0007	
S*L	0.003	0.001	

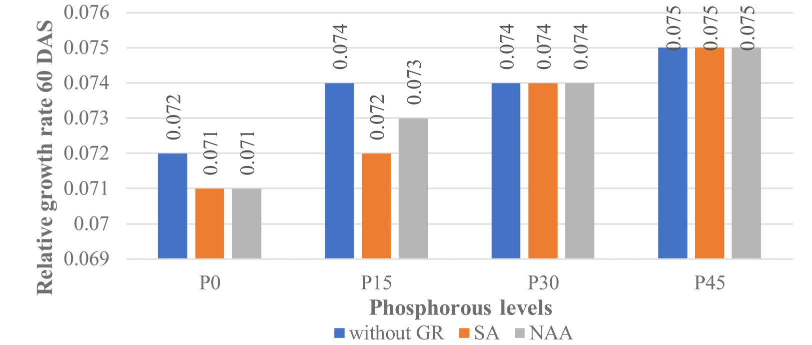
Fig. 3b

Fig. 3a. Effect of phosphorus and growth regulators on crop growth rate (g m^{-2} day^{-1}) 60 DAS. **Fig. 3b.** Effect of phosphorus and growth regulators on crop growth rate (g m^{-2} day^{-1}) at 90 DAS.

nificant effect on phosphorus levels. The maximum leaf area index at 60 DAS i.e., (0.64) due to higher phosphorus application @ 45 kg P_2O_5 ha^{-1} and lowest (0.41) over @ 0 kg P_2O_5 ha^{-1} as displayed in Fig.1b. The data also reveals that leaf area index at the stage of 90 DAS increased significantly due to application of phosphorus levels up to 45 kg P_2O_5 ha^{-1} and plant growth regulators. However, the highest leaf area index (2.14) was noticed in the 45 kg P_2O_5 ha^{-1} with Naphthalene acetic acid 40 ppm, followed by 45 kg P_2O_5 ha^{-1} with Salicylic acid 100 ppm (1.95) and lowest 0.90 in control as shown in Fig.1c. These research findings are further strengthened by Mouri *et al.* (2018), Behera *et al.* (2017).

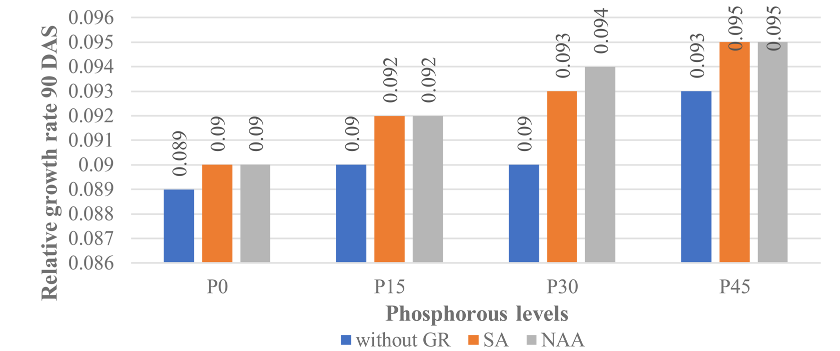
Effect of phosphorus and growth regulators on dry matter (t/ha) at 30, 60, 90 DAS

The data from Fig. 2 (a,b,c) indicates that increasing the phosphorus levels and growth regulators (S*L)



	CD	SE	CV
Source	NS	0.0005	2.34
Levels	0.002	0.0006	
S*L	NS	0.001	

Fig. 4a



	CD	SE	CV
Source	0.002	0.0006	2.03
Levels	0.002	0.0006	
S*L	NS	0.001	

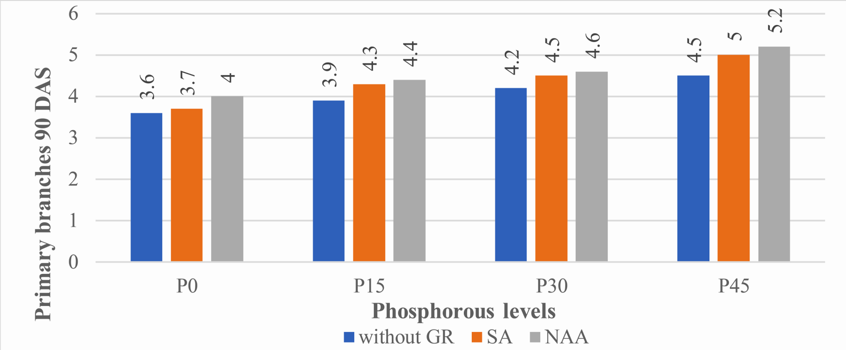
Fig. 4b

Fig. 4a. Effect of phosphorus and growth regulators on relative growth rate (g g^{-1} day^{-1}) at 60 DAS. **Fig. 4b.** Effect of phosphorus and growth regulators on relative growth rate (g g^{-1} day^{-1}) at 90 DAS.

had a significant effect on dry matter at 30, 60 and 90 DAS. At 30 and 60 DAS dry matter accumulation shows significant effect on phosphorus levels. The maximum dry matter accumulation at 60 DAS i.e., (1.80) due to higher phosphorus application @ 45 kg P_2O_5 ha^{-1} followed by 30 kg P_2O_5 ha^{-1} and lowest (1.34) over @ 0kg P_2O_5 ha^{-1} as mentioned in Fig. 2b. The data also reveals that dry matter at the stage of 90 DAS increased significantly due to application of phosphorus levels up to 45 kg P_2O_5 ha^{-1} and plant growth regulators. However, the highest dry matter (7.06) by application of phosphorus level @ 45 kg P_2O_5 ha^{-1} with Naphthalene acetic acid 40 ppm followed by 45 kg P_2O_5 ha^{-1} with Salicylic acid 100 ppm and lowest (4.77) over control in Fig. 2c. These finding investigations are also reported by Behara *et al.* (2017), Potdar *et al.* (2019).

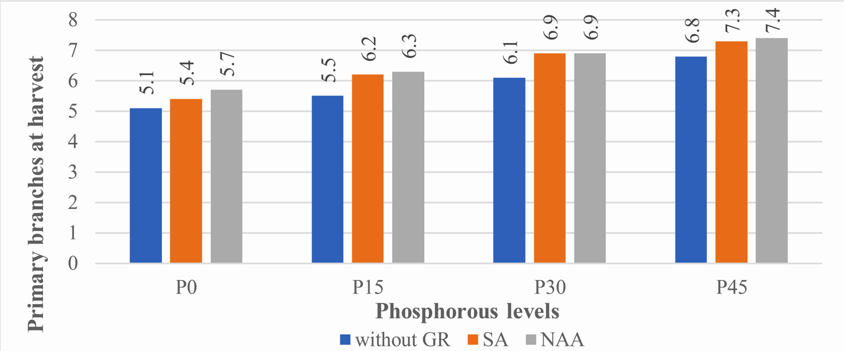
Effect of phosphorus and growth regulators on crop growth rate (g m^{-2} day^{-1})

CGR represents as a valuable parameter for crop



	CD	SE	CV
Source	0.09	0.03	2.47
Levels	0.10	0.04	
S*L	NS	0.06	

Fig. 5a



	CD	SE	CV
Source	0.08	0.03	1.59
Levels	0.10	0.03	
S*L	0.17	0.06	

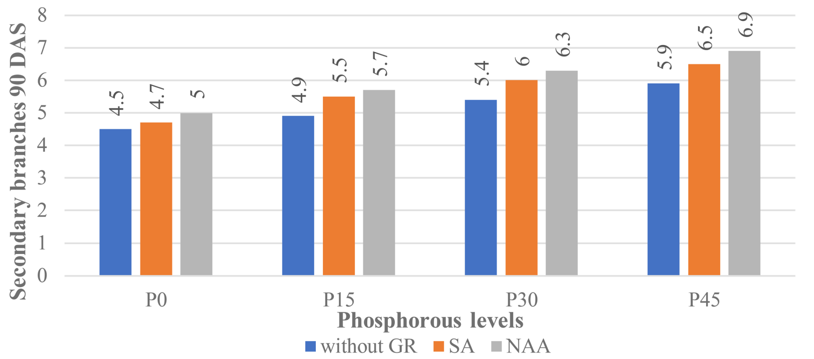
Fig. 5b

Fig. 5a. Effect of phosphorus and growth regulators on number of primary branches at 90 DAS. **Fig. 5b.** Effect of phosphorus and growth regulators on number of primary branches at harvest stage.

production on the basis of dry matter production rate. The data from Fig. 3 (a, b) indicates that increasing the phosphorus levels and growth regulators (S*L) had no significant effect on crop growth rate at 60 DAS at 90 DAS, shows significant effect on CGR. The CGR of mustard was significantly increased with the application of increasing levels of phosphorus. At 60 DAS, CGR increases by increasing the level of phosphorus. Highest CGR observed in 45 kg P_2O_5 ha^{-1} followed by 30 kg P_2O_5 ha^{-1}. There was a significant variation was observed at 90 DAS, due to different levels of phosphorus with application of growth regulators. However, the highest CGR at 90 DAS (0.06) by the treatment of 45 kg P_2O_5 ha^{-1} with Naphthalene acetic acid 40 ppm followed by 45 kg P_2O_5 ha^{-1} with Salicylic acid 100 ppm and lowest (0.04) over control in Fig. 3b. According to Behara *et al.* (2017), Yasari *et al*. (2008) correlates the present findings.

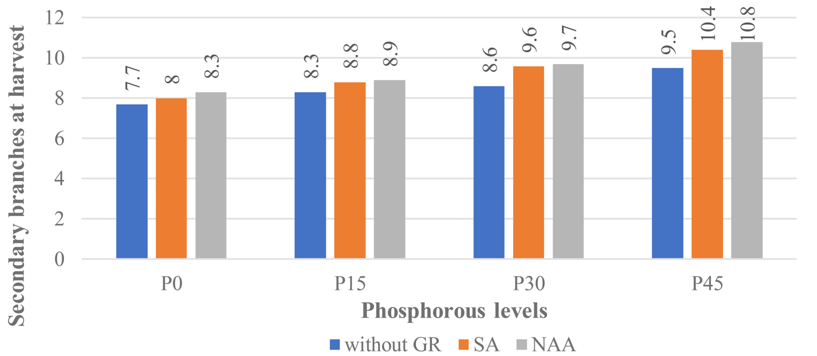
Effect of phosphorus and growth regulators on relative growth rate (g g^{-1} day^{-1})

The data from Fig.4 (a, b) indicates that increasing the phosphorus levels and growth regulators (S*L) had no significant effect on relative growth rate (RGR) at 60 and 90 DAS. At 60 DAS, the results related to



	CD	SE	CV
Source	0.11	0.04	2.40
Levels	0.13	0.05	
S*L	0.23	0.08	

Fig. 6a



	CD	SE	CV
Source	0.12	0.04	1.61
Levels	0.14	0.05	
S*L	0.25	0.08	

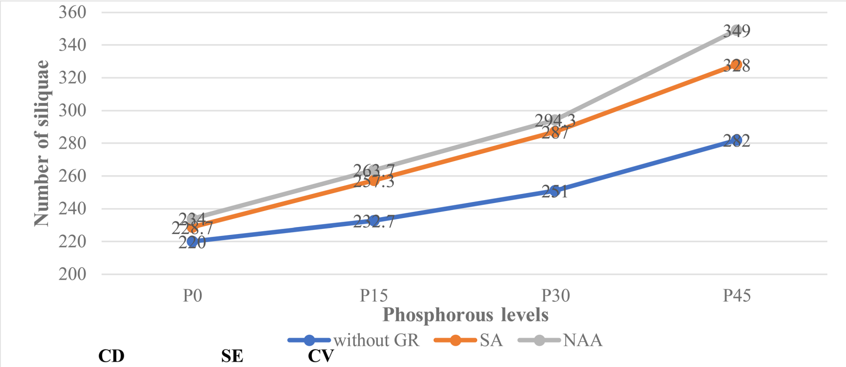
Fig. 6b

Fig. 6a. Effect of phosphorus and growth regulators on number of secondary branches at 90 DAS. **Fig. 6b.** Effect of phosphorus and growth regulators on number of secondary branches at harvest stage.

the relative growth rate of mustard at the stage of 60 DAS, RGR increases by increasing the level of phosphorus. Highest RGR observed in 45 kg P_2O_5 ha^{-1} followed by 30 kg P_2O_5 ha^{-1}. In 60 DAS application of 45 kg P_2O_5 ha^{-1} increased the higher RGR (0.075) followed by 30 kg P_2O_5 ha^{-1} and lowest (0.071) in P level 0 kg P_2O_5 ha^{-1} was observed in Fig. 4a. RGR was decreased at the level of 0 kg P_2O_5 ha^{-1}. At the stage of 90 DAS relative growth rate increased significantly, due to phosphorus levels with application of growth regulators. However, the highest RGR at 90 DAS (0.095) by the application of 45 kg P_2O_5 ha^{-1} with Naphthalene acetic acid 40 ppm followed by 45 kg P_2O_5 ha^{-1} with Salicylic acid 100 ppm and lowest (0.089) was noticed in Fig. 4b. These alike results are also reported by Behera *et al.* (2017), Yasari *et al*. (2008).

Effect of phosphorus and growth regulators on number of primary branches

The data from Fig. 5 (a, b) indicates that increasing the phosphorus levels and application of growth regulators (S*L) had no significant effect on number



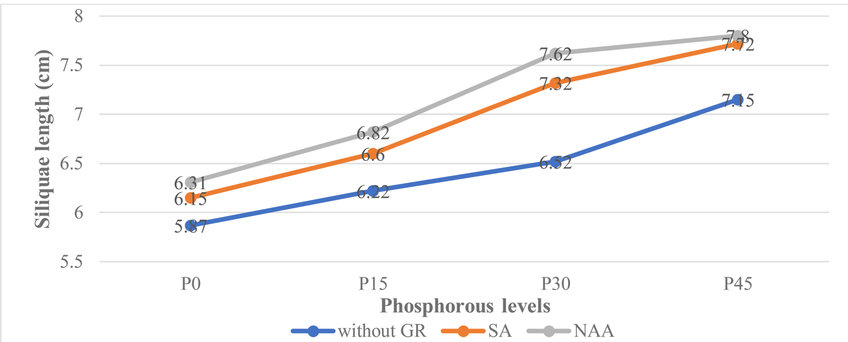
	CD	SE	CV
Source	5.02	1.71	2.21
Levels	5.80	1.98	
S*L	10.05	3.43	

Fig. 7. Effect of phosphorus and growth regulators on number of siliquae per plant.

of primary branches at 90 DAS and at harvesting stage (S*L) shows significant effect on the number of primary branches. The number of primary branches in Gobhi Sarson was significantly increased with the application of increasing levels of phosphorus up to 45 kg P_2O_5 ha^{-1} and growth regulators. At 90 DAS, higher number of primary branches (5.2) by the application of 45 kg P_2O_5 ha^{-1} with Naphthalene acetic acid 40 ppm followed by 45 kg P_2O_5 ha^{-1} with Salicylic acid 100 ppm (4.96) and lowest (3.6) in control was observed. However, at harvest stage higher number of primary branches (7.4) same as 90 DAS treatment 45 kg P_2O_5 ha^{-1} with NAA followed by 45 kg P_2O_5 ha^{-1} with SA (7.3) and lowest (5.1) in control as shown in Fig. 5b. These findings are consonance with Prasanth *et al.* (2018), Soman *et al*. (2017).

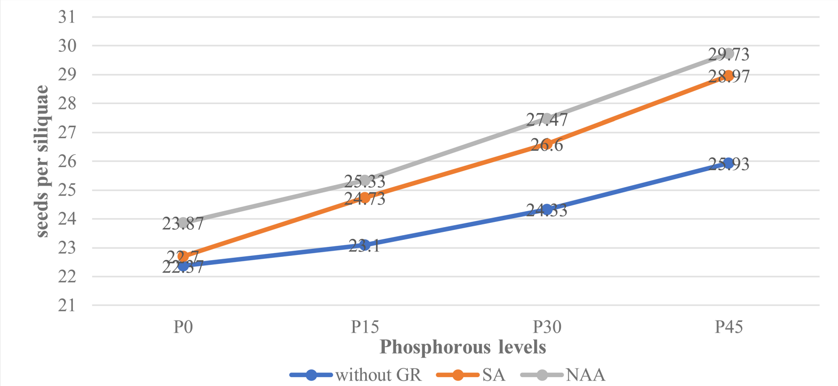
Effect of phosphorus and growth regulators on number of secondary branches

The data from Fig. 6 (a, b) indicates that increasing the phosphorus levels and application of growth regulators (S*L) had a significant effect on the number



	CD	SE	CV
Source	0.06	0.02	1.0
Levels	0.07	0.02	
S*L	0.12	0.04	

Fig. 8. Effect of phosphorus and growth regulators on siliquae length (cm).



	CD	SE	CV
Source	0.62	0.21	2.88
Levels	0.72	0.24	
S*L	NS	0.42	

Fig. 9. Effect of phosphorus and growth regulators on seeds per siliquae.

of secondary branches at 90 and at harvest stage. The number of secondary branches in Gobhi Sarson was significantly increased with the application of increasing levels of phosphorus up to 45 kg P_2O_5 ha^{-1} and growth regulators (NAA and SA). At 90 DAS, higher number of secondary branches (6.9) by the application of 45 kg P_2O_5 ha^{-1} with Naphthalene acetic acid 40 ppm followed by 45 kg P_2O_5 ha^{-1} with Salicylic acid 100 ppm (6.5) and lowest (4.5) in control was observed. However, at harvest stage higher number of secondary branches (10.8) by the application of 45 kg P_2O_5 ha^{-1} with NAA 40 ppm, followed by 45 kg P_2O_5 ha^{-1} with SA 100 ppm (10.4) and lowest (7.7) in control treatment as mentioned in Fig. 6b. These analogous results are also reported by Prasanth *et al.* (2018), Soman *et al.* (2017).

Effect of phosphorus and growth regulators on number of siliquae per plant

The data from Fig. 7 indicates that increasing the phosphorus levels and application of growth regulators (S*L) had a significant effect on the total no. of siliquae per plant. The number of siliquae per plant was significantly increased with the application of increasing levels of phosphorus up to 45 kg P_2O_5 ha^{-1} and growth regulators (NAA and SA). The higher number of siliquae per plant (349) by the application of 45 kg P_2O_5 ha^{-1} with NAA 40 ppm, followed by 45 kg P_2O_5 ha^{-1} with SA 100 ppm (328) and lowest (220) in control treatment. These results of present investigations are supported by Potdar *et al.* (2019), Siddik *et al*. (2016).

Effect of phosphorus and growth regulators on siliquae length (cm)

The results presented in Fig. 8 indicates that increasing the phosphorus levels and application of growth regulators (S*L) had a significant effect on siliquae length. The length of siliquae was significantly increased with the application of increasing levels of phosphorus up to 45 kg P_2O_5 ha^{-1} and growth regulators (NAA and SA). The higher siliquae length is (7.8 cm) was recorded in 45 kg P_2O_5 ha^{-1} with Naphthalene acetic acid 40 ppm followed by 45 kg P_2O_5 ha^{-1} with Salicylic acid 100 ppm (7.72 cm) and lower siliquae length (5.87 cm) over control. It was observed that 45 kg P_2O_5 ha^{-1} with NAA 40 ppm found that significantly better over control as well as other 3 levels (0,15 and 30 P_2O_5 ha^{-1}) with NAA 40 ppm and SA 100 ppm. Analogous results are reported by Siddik *et al.* (2016), Khanam *et al.* (2016).

Effect of phosphorus and growth regulators on seeds per siliquae

The number of seeds per siliquae recorded in 4 levels

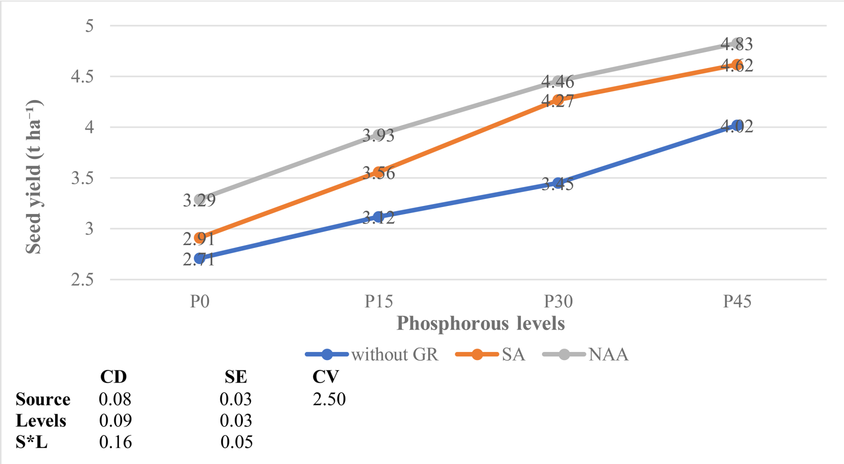


Fig. 10. Effect of phosphorus and growth regulators on seed yield (t ha^{-1}).

of phosphorus with and without growth regulators application is given in Fig. 9. Indicates that increasing the phosphorus levels and application of growth regulators (S*L) had no significant effect on seeds per siliquae. The number of seeds per siliquae was increased with the application of increasing levels of phosphorus up to 45 kg P_2O_5 ha^{-1} and growth regulators (NAA and SA). The higher number of seeds per siliquae (29.73) was recorded in 45 kg P_2O_5 ha^{-1} with Naphthalene acetic acid 40 ppm followed by 45 kg P_2O_5 ha^{-1} with Salicylic acid 100 ppm (28.96) and lowest seeds per siliquae (22.7) over control. These research findings are further strengthened by Minakshi (2017), Soman *et al*. (2017).

Effect of phosphorus and growth regulators on seed yield (t ha^{-1})

The data presenting the seed yield (t ha^{-1}) as influenced by effect of phosphorus and growth regulators are given in Fig. 10. It indicates the increasing the phosphorus levels and application of growth regulators (S*L) had a significant effect on seed yield. Seed yield (t ha^{-1}) was increased with the application of increasing levels of phosphorus up to 45 kg P_2O_5 ha^{-1} and growth regulators (NAA and SA). Maximum seed yield (4.83 t ha^{-1}) was recorded in application of 45 kg P_2O_5 ha^{-1} with Naphthalene acetic acid 40 ppm (T_{12}) followed by 45 kg P_2O_5 ha^{-1} with Salicylic acid 100 ppm (T_8) (4.62 t ha^{-1}) and lowest seed yield (2.71 t ha^{-1}). These findings are consonance with Rahul *et al.* (2018), Soman *et al.* (2017).

CONCLUSION

The present study indicates that, treatment combination of T_{12}, application of higher level of phosphorus i.e., 45 kg P_2O_5 ha^{-1} along with growth regulator Naphthalene acetic acid @ 40 ppm and followed by T_8 45 kg P_2O_5 ha^{-1} with Salicylic acid @ 100 ppm has recorded best treatment compared to others and resulted significantly higher growth and yield of Gobhi Sarson. The research findings will be used to conduct a multifaceted analysis to assess the effect of phosphorus and growth regulators on growth, yield and quality of Gobhi Sarson.

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