Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(5): 621-627
Received: 14-07-2020
Accepted: 18-08-2020

Gagandeep Singh
Department of Agronomy,
CSKHPKV Palampur,
Himachal Pradesh, India

AK Bindra
Department of Agronomy,
CSKHPKV Palampur,
Himachal Pradesh, India

Corresponding Author:
Gagandeep Singh
Department of Agronomy,
CSKHPKV Palampur,
Himachal Pradesh, India

Effect of planting density on brown sarson (*Brassica campestris* var. brown sarson) under different levels of nitrogen and phosphorus in mid-hills of Himachal Pradesh

Gagandeep Singh and AK Bindra

Abstract
A field experiment was conducted to study the "Effect of planting density on brown sarson (*Brassica campestris* var. brown sarson) under different levels of nitrogen and phosphorus in mid-hills of Himachal Pradesh" during *Rabi* season of 2014-15 at the Research Farm of Department of Agronomy, Forages and Grassland Management, CSKHPKV, Palampur. The treatments comprising of 3 planting densities, 3 nitrogen levels and 2 phosphorus levels were replicated thrice using factorial randomized block design. Results have shown that yield attributes of brown sarson *viz*. primary and secondary branches per plant, no. of siliquae per plant, seeds per siliqua, 1000-seed weight were found to be significantly higher at 25 plants/m^2 but 90 kg N/ha and 60 kg P_2O_5/ha showed similar positive effect on yield attributes also. higher seed yield was recorded in treatment combination of 50 plants/m^2 alongwith 60 kg N/ha and 60 kg P_2O_5/ha. Higher gross and net returns were obtained from the planting density of 50 plants/m^2 which also gave higher B:C ratio.

Keywords: Brown sarson, yield attributes, yield, quality, planting density

Introduction
India is the fourth largest oilseed producer contributing to around 11% of the world's total production, next to USA, China and Brazil. India occupies the first position in area and second position in production after China among the rapeseed mustard growing countries in the world. Mustard accounts for nearly 20-22% of the total oilseeds produced in the country (Anonymous 2015a) [2]. Among different oilseeds, India produces around 65 lakh tonnes of rapeseed mustard and around 26 lakh tonnes of rapeseed mustard oil and 35 lakh tonnes oilcake. Total area under rapeseed mustard in the country for the year 2014-15 was 61.90 lakh hectares (Anonymous 2015b) [3]. Rapeseed mustard is the second most important edible oilseed crop in India after groundnut and accounts for nearly 30% of the total oilseeds produced in the country. Futhermore, rapeseed mustard oil is one of the most important edible oils of northern and eastern parts of India. The oil obtained is rich in unsaturated and low in saturated fatty acids. In addition to the oil, most plant parts of rapeseed-mustard such as seeds, sprouts, leaves and tender parts are also of great use to human health, and consumed as spices and vegetables. In Himachal Pradesh, also rapeseed mustard group has an emense importance and occupies first position among oilseeds (8.76 thousand ha area and 3.58 thousand tonnes production) (Anonymous 2015b) [3]. Among the subspecies of rapeseed mustard group of crops, brown sarson has an important place. This crop in the state is mostly grown under rainfed conditions resulting in poor productivity as compared to the irrigated conditions. Out of many reasons of low productivity of sarson, low and imbalanced fertilizer application is one of the most important factors in the State. Therefore, balanced nutrient management is the most critical input for obtaining optimum yield in rapeseed mustard all over India (Shanker *et al*. 2002) [28]. Crop yields are also affected by competitive stress among individual plants. Hence, establishment of optimum plant population by maintaining proper row to row or plant to plant spacing is one of the important factors to minimize ompetition and secure a better translocation of photosynthates, consequently which renders better yield. Therefore, keeping in view the above facts the present study had been formulated to study the effect of planting density and levels of nitrogen and phosphorus on productivity and profitability of brown sarson

Material and Methods
The field experiment entitled, "Effect of planting density on brown sarson (*Brassica campestris* var. brown sarson) under different levels of nitrogen and phosphorus in mid-hills of Himachal Pradesh" was conducted during *Rabi* season of 2014-15 at Research Farm of

Department of Agronomy, Forages and Grassland Management, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (H.P.). The experimental farm is located at 32º6' N latitude, 76º3' E longitude and an altitude of 1290 meters above mean sea level. The site falls in the Sub-Temperate Mid-Hill Zone of Himachal Pradesh. Prior to the conduct of present experiment, the field was under cultivation of maize crop in *Kharif* and wheat crop during *Rabi* for past number of years. The brown sarson variety HPBS-1 was sown in plots with different plant density *viz*. 50, 33 and 25 plants/m^2 at different levels of nitrogen and phosphorus. The field experiment was laid out in factorial randomized block design consisting of three replications. The details of eighteen treatment combinations consisting of three levels of planting densities, three levels of nitrogen and two levels of phosphorus are given below:

A. Planting density
1. 50 plants/m^2 (20 × 10 cm)
2. 33 plants/m^2 (30 × 10 cm)
3. 25 plants/m^2 (40 × 10 cm)

B. Nitrogen levels (kg/ha)
1. N_{30}
2. N_{60}
3. N_{90}

C. Phosphorus levels (kg/ha)
1. P_{40}
2. P_{60}

Total number of primary and secondary braches were counted from five tagged plants and averaged to get number of branches per plant near to harvesting of the crop. All the siliquae from the five tagged plants were counted and then averaged to get the number of siliquae per plant. Five siliquae from each of the five tagged plants were plucked at random. Then these siliquae were threshed, seeds were cleaned, counted and averaged to get number of seeds per siliqua. Random **s**eed samples from the produce of net plot were collected and thousand seeds were counted, dried thoroughly and then weight was recorded. Net plot was harvested after removing two border rows from each gross plot and 30 cm each from either sides of the plot. After threshing and cleaning the produce, the seeds were dried and seed yield was expressed as kg/ha. After sun drying, the weight of the total biomass harvested from the net plot was recorded. The straw yield was calculated by subtracting the seed yield from the total biological yield which contained straw and seeds and expressed as kg/ha. Harvest index (HI) was worked out by dividing grain yield with biological yield as per formula given below:

$$HI = \frac{\text{Grain yield (kg/ha)}}{\text{Biological yield (kg/ha)}}$$

The seed samples were oven dried at 70 ºC till constant weight. The oil content was determined with the help of Soxhlet's extraction method (A.O.A.C 1970) [4]. The oil content was expressed in %. Oil yield was calculated by multiplying seed yield and oil content in the seeds. The seed samples collected at harvest were used for estimation of total nitrogen content. Total nitrogen was determined using the modified micro Kjeldahl method (A.O.A.C. 1970) [4]. The % crude protein was calculated by multiplying % nitrogen with a constant factor of 6.25. Economics of different treatments was worked out by calculating cost of cultivation, gross and net returns per hectare and benefit: cost ratio. The value of the produce and biproduce was obtained on the basis of prevailing selling prices in the university farm and expressed in Rs./ha. Net returns were computed by subtracting the cost of cultivation from the gross returns. The returns per rupee invested were calculated as follow:

$$\text{Benefit: cost ratio (B: C)} = \frac{\text{Net returns (Rs. /ha)}}{\text{Cost of cultivation (Rs. /ha)}}$$

The data obtained for different parameters were subjected to statistical analysis as per Gomez and Gomez (1984) [13] and were tested at 5% level of significance to interpret the treatment differences.

Results and Discussion

Number of primary branches

The data recorded on number of primary branches presented in the table (1) revealed that maximum number of primary branches were observed in planting density of 25 plants/m^2 which remained significantly superior to other treatments. Planting density of 50 plants/m^2 resulted in minimum number of primary branches per plant which was found to be statistically at par with the planting density of 33 plants/m^2. Mamun *et al*. (2014) [20] also reported similar results showing higher number of branches per plant at lower densities. This was due to lesser competition within the plants and sufficient light intensity was a potent source for increasing crop biomass, resulting higher number of branches per plant (Rana and Pachauri 2001; Siadat *et al*. 2010) [24, 30]. Among different nitrogen levels significantly higher number of primary branches were recorded with the application of 90 kg N/ha followed by 60 kg N/ha though latter remained statistically superior to 30 kg N/ha. Singh and Singh (2002) [32] reported similar type of response of nitrogen giving higher number of primary branches at higher levels of nitrogen in Indian mustard (*Brassica juncea*). Similarly, with the application of phosphorus at different levels, a dose of 60 kg P_2O_5/ha gave significantly higher number of primary branches compared to 40 kg P_2O_5/ha. Similar findings were also reported by Khatkar *et al*. (2009) [17]. This was because of the fact that phosphorus encourages the cell division and cell elongation in the meristematic region of the plant, thus resulted in improved growth and development of the plant.

Number of secondary branches

The data collected on number of secondary branches per plant have been presented in table 1. Planting density of 25 plants/m^2 recorded significantly higher number of secondary branches and remained at par with 33 plants/m^2 planting density. But it remained statistically superior to planting density of 50 plants/m^2. Mamun *et al*. (2014) [20] also obtained higher number of secondary branches per plant at lower densities. This might be due to lesser competition within the plants and sufficient light intensity leading to increased crop biomass (Rana and Pachauri 2001; Siadat *et al*. 2010) [24, 30]. The data showed that significantly higher number of secondary branches were recorded with the application of 90 kg N/ha which was found at par with application of 60 kg N/ha, but significantly higher than 30 kg N/ha. Singh and Singh (2002) [32] reported similar response of nitrogen giving higher number of secondary branches in Indian mustard (*Brassica juncea*) at higher levels of nitrogen. The perusal of data revealed that significantly higher number of secondary branches were recorded with 60 kg P_2O_5/ha than 40 kg P_2O_5/ha. Similar findings were also reported by Khatkar *et al*. (2009) [17] in which they found that with application of 60 kg P_2O_5/ha, numbers of secondary branches were significantly increased over the 40 kg P_2O_5/ha. This might be because of the fact that phosphorus encourages the cell division and cell elongation in the meristematic region of the plant, thus resulted in improved growth and development of the plant. These results are also in close conformity with the findings of Dubey and Khan (1993) [12].

Number of seeds per siliqua

The data presented in table 1 showing the effect of treatments on number of seeds per siliqua. Data revealed that planting density of 25 plants/m^2 remaining at par with 33 plants/m^2 resulted in significantly higher number of seeds per siliqua as compared to the planting density of 50 plants/m^2. These findings are in close confirmation with those of Keivanrad and Zandi (2014) [16]. Significantly higher number of seeds per siliqua were recorded with the application of 90 kg N/ha but it remained statistically at par with 60 kg N/ha. Minimum number of seeds per siliqua were observed with application of 30 kg N/ha. Qayyum *et al*. (1998) [23] and Cheema *et al*. (2001) [8] also reported an increase in number of seeds per siliqua with increase in nitrogen dose. Significantly higher number of seeds per siliqua were obtained in plants treated with 60 kg P_2O_5/ha than 40 kg P_2O_5/ha. Tahir *et al*. (2003) [34] also found that different levels of P_2O_5 had significant effect on number of seeds per siliqua of canola. There was an increase in number of seeds per siliqua with an increase in P_2O_5 up to 50 kg/ha. Similar results in *Brassica* spp. were reported by Chauhan *et al*. (1995) [7] and Cheema (1999) [10].

Table 1: Effect of different treatments on yield attributes of brown sarson

Treatment	No. of primary branches per plant	No. of secondary branches per plant	No. of seeds per siliqua	No. of siliquae per plant	1000 seed weight (g)
Planting density (plants/m^2)					
50 (20 × 10 cm)	5.4	6.8	8.29	256.0	3.23
33 (30 × 10 cm)	5.5	7.0	8.53	259.6	3.41
25 (40 × 10 cm)	5.9	7.3	8.66	263.2	3.45
CD (P=0.05)	0.2	0.4	0.19	1.1	0.12
Nitrogen levels (kg/ha)					
30	5.3	6.8	8.12	257.9	3.13
60	5.6	7.0	8.59	259.0	3.34
90	5.9	7.3	8.76	262.0	3.63
CD (P=0.05)	0.2	0.4	0.19	1.1	0.12
Phosphorus levels (kg/ha)					
40	5.4	6.8	8.37	258.0	3.30
60	5.9	7.3	8.61	261.3	3.43
CD (P=0.05)	0.2	0.3	0.16	0.9	0.10

Number of siliquae per plant

The observations recorded on number of siliquae per plant have been tabulated in table 1. A cursory glance at the data indicated that planting density of 25 plants/m^2 recorded significantly higher number of siliquae per plant followed by planting density of 33 plants/m^2 and 50 plants/m^2. These findings are in agreement with those of Mcgregor (1987) [21], Ali *et al*. (1996) [1] and Cheema *et al*. (2001) [8]. This was due to the reason that, with increase in density the number of siliquae per plant would decrease due to closer space and more competition (Kjellstrom 1995) [18]. Significantly higher number of siliquae per plant were recorded with the application of 90 kg N/ha which was followed by application of 60 kg N/ha and further by 30 kg N/ha. But latter two levels remained at par with each other. These results confirmed the findings of earlier researchers (Mobasser *et al*. 2008; Siadat *et al*. 2010) [22, 30]. The results showed that maximum number of seeds per siliqua were obtained with 60 kg P_2O_5/ha which were significantly higher than 40 kg P_2O_5/ha. Chauhan *et al*. (1995) [7] and Arthamwar *et al*. (1996) [5] also reported that increasing the rate of P fertilizer increased siliquae per plant.

1000-seed weight

The data pertaining to 1000-seed weight has been presented in table 1. The data indicated that planting density of 25 plants/m^2 being statistically at par with planting density of 33 plants/m^2 resulted in significantly higher 1000-seed weight than planting density of 50 plants/m^2. Kardgara *et al*. (2010) [15] also reported the same results showing that the lower densities had the highest 1000-seed weight and the highest density had the lowest values. The data revealed that application of 90 kg N/ha resulted in significantly higher 1000-seed weight as compared to other treatments. Application of 30 kg N/ha gave minimum 1000-seed weight in brown sarson. The findings are in close conformity with those obtaining by Singh and Meena (2004) [31]. Among levels of phosphorous it was observed that significantly higher 1000-seed weight was obtained in plants treated with 60 kg P_2O_5/ha as compared to 30 kg P_2O_5/ha. These results are in accordance with the findings of Kumar and Yadav (2007) [19] who reported that this may be due to large amount of phosphorus found in the seed and siliqua, which is considered essential for seed formation and boldness of seeds.

Seed yield

The data on seed yield of brown sarson as influenced by planting density, nitrogen levels and phosphorous levels have been presented in the table 2. A perusal of data showed that planting density having 50 plants/m^2 significantly increased the seed yield of brown sarson over planting density of 33 plants/m^2 and 25 plants/m^2, respectively. Further it was observed that planting density of 33 plants/m^2 was found to be statistically superior to 25 plants/m^2. The seed yield, so obtained from 50 plants/m^2 was to the tune of 1.31% higher over 33 plants/m^2. But when the planting density was reduced to half i.e. 25 plants/m^2 the seed yield increased up to 19.01%. The significant higher values of yield contributing characters might have manifested there positive effect on the seed yield of brown sarson. However, even with lower values of yield attributes planting density of 50 plants/m^2 resulted higher seed yield owing to higher number of plants per unit area. Mamun *et al*. (2014) [20] also observed that increase in planting density increased the seed yield. Seed yield of brown sarson significantly increased with each incremental dose of nitrogen from 30 kg/ha up to 90 kg/ha. However, 90 kg N/ha remained at par with 60 kg N/ha. Both these levels were found statistically superior to 30 kg N/ha. Hence, incremental dose of 30 kg N/ha up to 90 kg N/ha resulted in 3.6% increase in seed yield of brown sarson. Similar results showing increasing seed yield with increasing nitrogen application were also reported by Cheema *et al*. (2010) [9]. A perusal of data revealed that increasing the phosphorus level from 40 to 60 kg/ha has also increased the seed yield significantly. Application of 60 kg P_2O_5/ha resulted in significantly higher seed yield compared to 40 kg P_2O_5/ha. This might be due to developed root system and also by well vegetative reproduction of plant parts. Sharma and Jalali (2002) [29] also reported similar type of result.

Table 2: Effect of different treatments on seed yield, straw yield and harvest index of brown sarson

Treatment	Seed yield (kg/ha)	Straw yield (kg/ha)	Harvest index
Planting density (plants/m^2)			
50 (20 × 10 cm)	1144.9	7548.4	0.133
33 (30 × 10 cm)	1130.1	7157.8	0.137
25 (40 × 10 cm)	962.0	7093.0	0.120
CD (0.05)	7.0	62.7	0.001
Nitrogen levels (kg/ha)			
30	1055.9	7013.0	0.131
60	1087.2	7242.4	0.131
90	1093.9	7543.8	0.128
CD (0.05)	7.0	62.7	0.001
Phosphorus levels (kg/ha)			
40	1066.7	7137.2	0.131
60	1091.3	7395.6	0.129
CD (0.05)	5.7	51.2	0.001

Straw yield

The data pertaining to straw yield as affected by different planting densities and different levels of nitrogen and phosphorus have been presented in the table 2. The observations showed that significantly higher straw yield was observed in planting density of 50 plants/m^2 followed by the planting density of 33 plants/m^2 and subsequently by 25 plants/m^2. These results are in conformity with the findings of Islam *et al*. (1994) [14]. It was interpreted that significantly highest straw yield was recorded with application of 90 kg N/ha followed 60 kg N/ha and 30 kg N/ha, respectively. Several workers have also reported positive response of nitrogen application on straw yield of mustard (Singh and Meena 2004; Regar *et al*. 2006) [31, 25]. It is evident from the data given in table 2 that application of phosphorus at different levels significantly affected the straw yield of brown sarson. Significantly higher straw yield was obtained with application of 60 kg P_2O_5/ha, which was followed by application of 40 kg P_2O_5/ha.

Harvest index

The data recorded on the effect of planting density and different nitrogen and phosphorus levels on harvest index have been summarized in the table 2. It was apparent from the data that the planting density had significant effect on harvest index. Significantly higher harvest index was obtained in planting density of 33 plants/m^2 than other planting densities. Lowest harvest index was recorded in planting density of 25 plants/m^2. Delougherty and Crookston (1978) [11] reported that with increasing population density a significant decline in HI was achieved. Similar results were also reported by Shahraki *et al*. (2008) [27]. The data revealed that there was no significant difference in harvest index with 30 kg N/ha and 60 kg N/ha however both the nitrogen levels resulted in significantly higher harvest index as compared to 90 kg N/ha. These results are in conformity with the findings of Keivanrad and Zandi (2014) [16]. The data also revealed that 40 kg P_2O_5/ha gave significantly higher harvest index as compared to application of 60 kg P_2O_5/ha. Similar results have also been reported by Tahir *et al*. (2003) [34].

Effect on quality

Protein content

The data pertaining to the effect of planting density, different nitrogen levels and phosphorous levels on protein content have been summarized in the table 3. It was apparent from data that higher protein content was recorded at planting density of 25 plants/m^2. Differences were significant from 33 plants/m^2 planting density but latter was statistically at par with 50 plants/m^2. It was also revealed that 90 kg N/ha produced more percentage of protein than 60 kg N/ha. However, 60 kg N/ha remained at par with the application of 30 kg N/ha. The increase in protein content might be due to higher nitrogen content in seeds, as increasing nitrogen level increases the proteinaceous substance in seeds (Singh and Pal 2011) [33]. A perusal of the data presented in same table indicated that the protein content was significantly higher in the plots receiving 60 kg P_2O_5/ha as compared to 40 kg P_2O_5/ha. These findings are in corroborate with those of Bharose *et al*. (2011) [6] showing maximum protein content of seeds in the treatment receiving the highest level of phosphorus.

Oil content and oil yield

The observations pertaining to the effect of treatments on oil content of brown sarson have been tabulated and presented in table 3. The data exhibited that among the planting densities, significantly higher oil content was obtained from planting density of 50 plants/m^2. However, it remained at par with planting density of 33 plants/m^2.

But both remained significantly superior to 25 plants/m^2. Kardgara *et al*. (2010) [15] observed the similar type of results in which the seeds produced at the higher density had the highest oil content. The lowest oil content was observed in the seeds produced at the lower densities. According to the data application of 30 kg N/ha remaining at par with 60 kg N/ha resulted in significantly higher oil content whereas, 90 kg N/ha remained inferior to both these nitrogen levels. These results are confirmed by Kardgara *et al*. (2010) [15].

Higher oil content was recorded with application of 60 kg P_2O_5/ha followed by 40 kg P_2O_5/ha. Bharose *et al*. (2011) [6] also observed that oil content of seeds was maximum in the treatment receiving the highest phosphorus level. The oil content was maximum due to the higher concentration of phosphorus.

Table 3: Effect of different treatments on protein content, oil content and oil yield

Treatment	Protein content (%)	Oil content (%)	Oil yield (kg/ha)
Planting density (plants/m^2)			
50 (20 × 10 cm)	18.6	43.1	485.8
33 (30 × 10 cm)	19.0	42.3	475.4
25 (40 × 10 cm)	20.3	42.1	416.1
CD (0.05)	0.5	0.8	7.5
Nitrogen levels (kg/ha)			
30	18.7	43.1	454.2
60	19.1	42.3	459.2
90	20.1	41.1	463.9
CD (0.05)	0.5	0.8	7.5
Phosphorus levels (kg/ha)			
40	18.8	41.9	447.2
60	19.8	43.0	469.3
CD (0.05)	0.4	0.7	6.7

Oil yield
A further perusal of data presented in table 3 showed that significantly higher oil yield was recorded in planting density of 50 plants/m^2 followed by 33 plants/m^2. The latter also remained statistically superior to planting density of 25 plants/m^2. The same table depicting the effect of different nitrogen levels indicated that significantly higher oil yield was recorded in plants treated with 90 kg N/ha followed by 60 kg N/ha whereas, it was found to be statistically at par with application of 30 kg N/ha. Lower oil yield was recorded from 30 kg N/ha application. The observation on effect of phosphorus depicted in table 3 also explained that application of 60 kg P_2O_5/ha showed significantly higher oil yield than 40 kg P_2O_5/ha.

Economics of treatments
The economics of treatments in terms of gross returns, net returns and B:C ratio have been presented in table 4.

Gross returns
Effect of different treatments on gross returns has been tabulated in table 4. The data revealed that at planting density of 50 plants/m^2 significantly higher gross returns were obtained as compared to other planting densities. It was followed by planting density of 33 plants/m^2 and the latter remained significantly superior to planting density of 25 plants/m^2.
Further, it can be seen from the same table that application of 90 kg N/ha resulted in maximum gross returns which was followed by 60 kg N/ha. However, minimum gross returns were observed with the application of 30 kg N/ha. It was also observed that maximum gross returns were obtained with the application of 60 kg P_2O_5/ha as compared to 40 kg P_2O_5/ha.

Net returns
A perusal of the data given in the table 4 showed the impact of different planting densities on net returns. The data indicated that significantly highernet returns were obtained in the treatment having planting density of 50 plants/m^2. However, planting density of 25 plants/m^2 resulted in minimum net returns remaining significantly inferior to 33 plants/m^2.

Table 4: Effect of different treatments on gross returns, net returns and B:C ratio

Treatment	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Planting density (plants/m^2)			
50 (40 × 10 cm)	34172	14914	1.78
33 (30 × 10 cm)	33646	14587	1.77
25 (20 × 10 cm)	28922	10064	1.54
CD (P=0.05)	198	198	0.01
Nitrogen levels (kg/ha)			
30	31529	12824	1.69
60	32469	13410	1.70
90	33243	13830	1.71
CD (P=0.05)	198	198	0.01
Phosphorus levels (kg/ha)			
40	31867	13465	1.73
60	32626	12912	1.65
CD (P=0.05)	162	162	0.01

Under different N levels maximum net returns were obtained with the application of 90 kg N/ha. However, it was followed by 60 kg N/ha but remained statistically superior to 30 kg N/ha in respect of the net returns/ha. In case of effect of phosphorus application of 40 kg P_2O_5/ha resulted in getting significantly maximum net returns as compared to 60 kg P_2O_5/ha.

B:C ratio
The table 4 depicted the data on the effect of different planting density on B:C ratio. It is evident from the observation that significantly higher B:C ratio was obtained with planting density of 50 plants/m^2. However, it remained at par with the planting density of 33 plants/m^2. But both treatments resulted in significantly higher B:C ratio as compared to 25 plants/m^2. The same table has the observations of B:C ratio as affected by different nitrogen levels. The data revealed that application of 90 kg N/ha remaining at par with 60 kg N/ha resulted in maximum B:C ratio over 30 kg N/ha. Phosphorous levels @ 40 kg P_2O_5/ha recorded significantly higher B:C ratio as compared to 60 kg P_2O_5/ha.

Conclusion

On the basis of results obtained, it was concluded that seed yield of brown sarson was significantly affected by different planting densities, nitrogen and phosphorus levels. The higher seed yield was recorded in 50 plants/m^2. Nitrogen level of 60 kg N/ha remained at par with 90 kg N/ha. Phosphorus level of 60 kg P_2O_5/ha resulted in significantly higher seed yield. A treatment combination of 50 plants/m^2 along with 60 kg N/ha and 60 kg P_2O_5/ha resulted in significantly higher seed yield of brown sarson in mid-hills of Himachal Pradesh. Higher net returns and B:C ratio were obtained at planting density of 50 plants/m^2. Nitrogen @ 90 kg N/ha and phosphorus @ 40 kg P_2O_5/ha gave higher net returns and B:C ratio, respectively.

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