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Effect of seed rate on the yield and yield components of Berseem (*Trifolium alexandrinum* L.)

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Abstract

Berseem is chief leguminous forage crop of Pakistan. Fodders are the best source of nutrition for animals. However, production of berseem is low due to inadequate seed rate. So, an experiment was designed to study the effect of seed rate on yield and yield components of berseem. The study was conducted at Fodder Research Institute, Sargodha, Punjab-Pakistan during 2015-16 and 2016-17. Different seed rates were used 10, 12.5, 15, 17.5, 20, 22.5, 25 kg ha^{-1}. The data related to plant height (cm), no. of capsule m^{-2}, no. of seedcapsule^{-1}, seed yield kg ha^{-1}, 1000 grain weight (grams) were taken at harvest. Significant differences were noted in all the parameters under study. Results indicated that 10 kg ha^{-1} has the highest potential to achieve maximum plant height (84.50 cm), no. of capsule (470 m^{-2}), no. of seedcapsule^{-1} (55.00), 1000 grain weight (898.33g) and seed yield (2.8 kg ha^{-1} under agro-climatic conditions of Sargodha.

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Introduction

Livestock is main sub division of agriculture in Pakistan and plays a vital role in country's economy. It added about 56.3% of the agricultural value addition and approximately 11.8% to the national GDP during 2014-15 (Farooq, 2015). In Pakistan, mixed farming (livestock-crop) systems are mostly adopted. Fodder crops are grown on 16–19% total cultivated area (Saeed *et al.*, 2011) in which berseem is the prominent fodder crop which is grown on an area of 710,000 ha and producing approximately 22.61 million tons of green forage annually (Farooq, 2015).

Berseem (*Trifolium alexandrinum* L.) commonly known as Egyptian clover, is major rabbi forage crop occupying maximum area during winter season (Hazra,1995). Berseem belongs to the family Leguminosae. On the Indo-Pakistan subcontinent, it was first introduced in the province of Sindh in 1904. Berseem is an annual grown clover and used as fodder for cattle. It has a shallow taproot system. Its stem is hollow, branching from base with alternate leaves. Its flowers are dense with white-yellowish color, elliptical clustered heads with 2cm in diameter. Its fruit un white color to purplish seed (Smoliak *et al.*, 2006). It is the most prevalent fodder in south-East Asia areas due to its fast growth, multicut and good fodder recovery after cutting, long fodder supply period, high tonnage yield with good palatability and great nutrition (Saini and chowdhury 1993). Limited activities of bees because poor fertilization (Dhaliwal and Atwal, 1976), the post-fertilization abortion cause pollen sterility in developing seeds (Pasumarty *et al*, 1993). There is difference among seed and forage yield of berseem and the possible reason for that is lack of available new varieties, required inputs, and inadequate seed rate (Anwar *et al.*, 2012).

Previous studies shown that seed rate is most important factor affecting yield of legumes (Martin *et al.*, 1994; Uzun and Acikgoz, 1998). Optimum seed rate is the most vital management component for increasing yield of any crop (Slafer and Satorre, 1999). If the seedling rates is more than the recommended it will may cause yield reduction (Beuerlein and Lafever, 1989). Seedling rates significantly affected achieved stands of crop (Stoppler *et al.*, 1990), no. of tillers and seed weight (Ozturk *et al.*, 2006). Higher rate of seed cause reduced tiller development and produce less tiller (Staggenborg *et al.*, 2003). For good crop growth and production, it is very important to apply adequate amount of seed. So, a field study was designed to check the effect of different seed rates on the yield and yield components of berseem under agro-climatic conditions of Sargodha.

Material and methods

Site and soil

The field trail was carried out during 2015-16 and 2016-17 at Fodder Research Institute, Sargodha Punjab Pakistan to check the effect of seven different seed rates on berseem yield and yield components. Samples of soil were taken from the experimental area and analyzed before sowing of seeds. The data regarding physiochemical analysis of the experimental soil is presented in Table 1.

Experimental design and the treatments

The field experiment was laid out in RCBD design with three number of replications. The treatments were comprised of seven seed rate (10, 12.5, 15, 17.5, 20, 22.5, 25 kg ha^{-1}) with four replications.

Crop husbandry

The soil was well prepared with rotavator. Two ploughings followed by planking were done and sowing was done by broadcast method. Seed rates were used as 10, 12.5, 15, 17.5, 20, 22.5, 25 kg ha^{-1}. Keeping in view soil analysis 1.25 bags/ha Urea, 3.75 bags/ha DAP (Diammonium phosphate), 2.5 bags SOP (Sulphate of Potash) were applied. Crop was sown on 15 Oct in 2015-16 and 2016-17 respectively.

All other recommended cultural practices were carried out normally for all plots. In first week of June crop was harvested and data regarding plant height (cm), no. of capsule m^{-2}, no. of seedcapsule^{-1}, 1000 grain weight (g) and seed yield kg ha^{-1}, were taken.

Data collection

Plant height: The data related to plant height was recorded in cm with the help of measuring rod by taking 5 plants per plot, and then calculated the average.

Number of capsule m^{-2}: The data of number of capsules were taken by counted capsules in m^{-2} plot and then calculated its average.

Number of seeds per capsule: Data of no. of seeds per capsule were recorded from 5 capsules taken randomly and seeds were counted from every capsule and then calculated its average. 1000 grain weight (g): Data regarding 1000 grain weight was recorded in grams with the help of weighing balance and then calculated its average.

Grain Yield (kg ha^{-1}): Data of grain yield was recorded in kg ha^{-1} with the help of weighing balance and average was calculated.

Statistical analysis

The data of two years were compiled, pooled and analyzed by using statistic version 8.1. After analysis of variance, the difference between the treatment means were compared by least significant difference test at probability level of 5% (Gomez and Gomez 1984).

Result and discussion

Plant height

Plant height is a very important component and mostly controlled by the genetic makeup and it can be effected by some environmental factors (Shahzad *et al.*, 2007). Data regarding plant height of berseem effected due to the different seed rates are presented in Fig. 1. Data shows significant difference among the treatments. Seed rate of 10 kg ha^{-1} gave the maximum height of plant (84.5 cm) while minimum plant height (20 cm) was recorded form the plot where seed was applied @ 25 kg ha^{-1} which was statically similar with 22.5 and 20 kg ha^{-1}.

Table 1. Physicochemical analysis of experimental soil.

Soil Analysis	EC mScm-1	pH	O.M (%)	P_2O_5 (mg/kg)	K_2O (mg/kg)
Observed	0.77	7.5	0.69%	6.3	135
Recommended	4	8.5	1.29%	14	180

Our results are quite similar with the research findings of Strikler *et al.* (1973) who stated that height of peanut plant significantly decreased due to increase in seed rate due to the response of more competition among the plants.

The reduction in height of plant might be due to more plants and more seedling and plants feel more nutrients and light competition among each other. Baloch *et al* (2010) also reported that the maximum wheat plant height (103.3 cm) was recoded with 150 kg ha^{-1} seed rate which was followed by seed rate of 175 kg seed ha^{-1}.

However, our results are not correlates with the findings of Sulieman (2010) who observed slight increase in plant height as seed rate increases. This might be due to environmental conditions.

Number of capsule m^{-2}

Data related to no. of capsules per m^{-2} affected due to the application of different seed rates is given in Fig. 2. The data shows that treatments differed significantly. Most number of capsules m^{-2} (470) were noted in the plot where we applied seed @ 10 kg ha^{-1} which was followed by 12.5 kg ha^{-1} (433) while 25 kg ha^{-1} seed rate gave least (233) number of capsules m^{-2}. Our research findings are similar with the research findings of Erdogdu *et al.* (2018) who reported that seed rate significantly influenced the number of capsules of someflax. Highest numbers of capsules were observed at 30 kg ha^{-1} seeds and least number of capsules were recorded from the 70 kg ha^{-1} seeds. This may due to the fact that crop plants are not able to make utilize enough sunlight because of more number of seeds, resulting lower growth of capsule (Diepenbrock and Parksen, 1992) and decline in leaves number and size when the density of plants are high and branches are shorter (Hassan and Leitch, 2000). Our results are also quite similar with the findings of Gabiana *et al.*, (2005) who stated that as the no. of seed increased number of capsules decreased significantly.

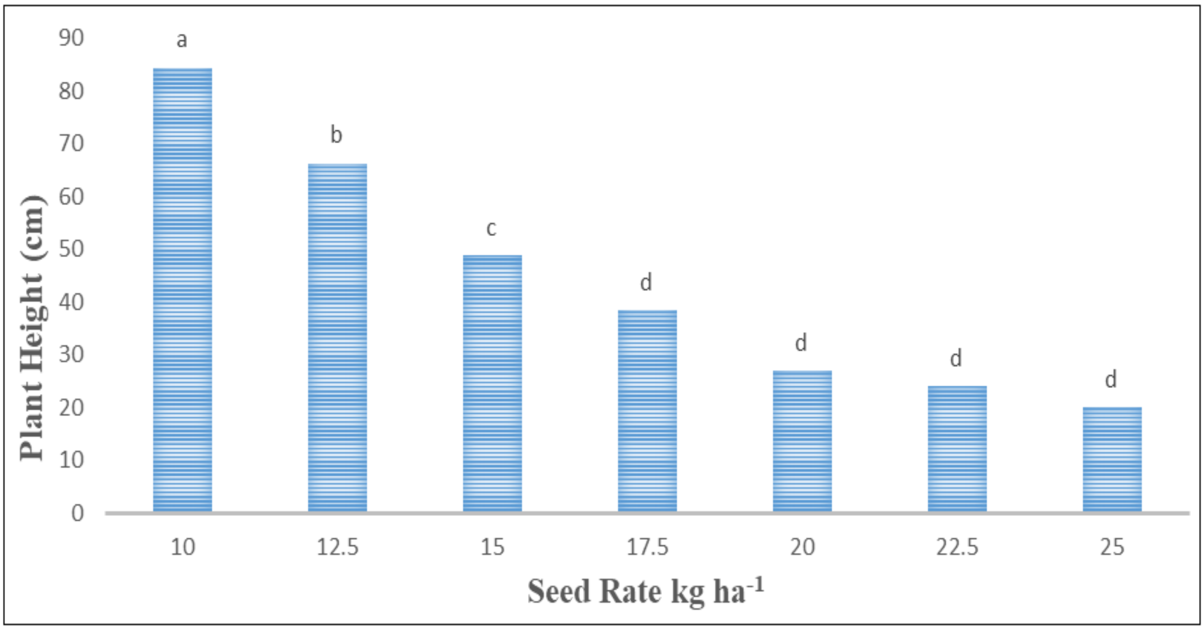

Fig. 1. Effect of different seed rates on plant height (cm) of berseem.

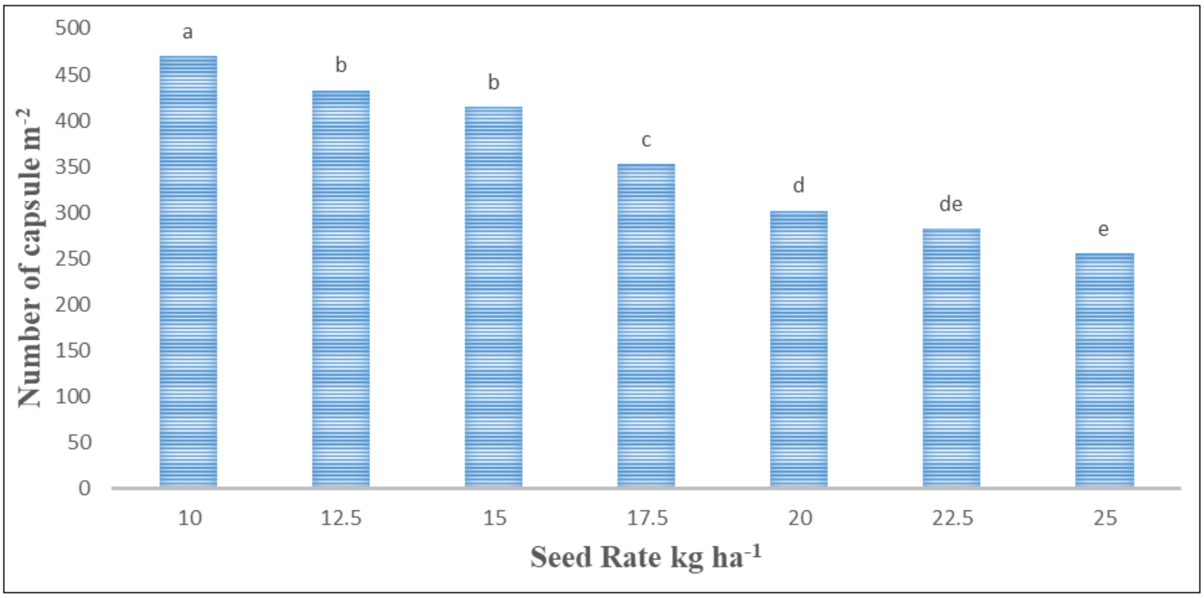

Fig. 2. Effect of different seed rates on number of capsule m^{-2} of berseem.

Number of seeds per capsule

No. of seeds per capsules is avital yield attributing parameter. The data regarding no. of seeds per capsule is presented in the Fig. 3. Data indicated that no. of seeds per capsules were significantly altered due to the different seed rate. Maximum no. of seeds per capsules (55) were observed at 10 kg ha^{-1} seed rate which was statistically same with the 12 kg ha^{-1} (54.33) whereas least no. of seeds per capsules (34.66) were counted from the plot where seed was applied @ 25 kg ha^{-1}. Our results are parallel with the findings Erdogdu *et al.* (2018) who described that highest number of someflax seeds were recorded (9) from the plot where seed was applied @ 30 kg per ha and least value of seeds (8.70) were observed with 70 kg per ha seed application.

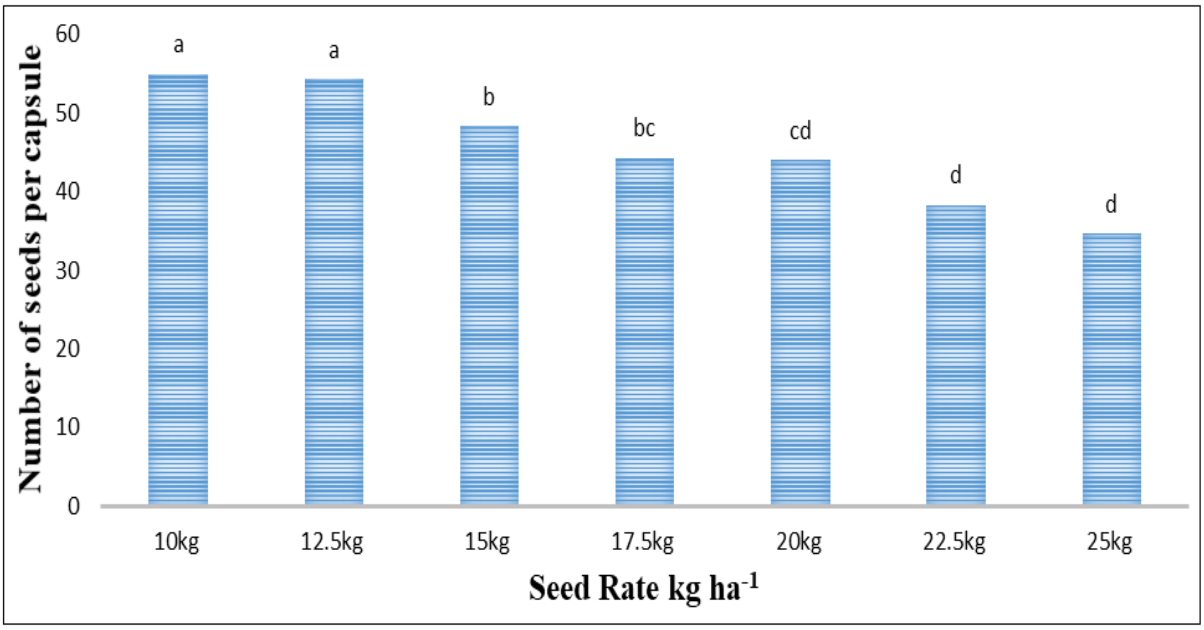

Fig. 3. Effect of different seed rates on number of seeds per capsule of berseem.

Our findings are also justified with the results of Gabiana *et al.* (2005) who stated that no. of seeds in the capsules significantly altered due to the amount of seed applied. The reduction in number of seeds may be due to more nutrient and light competition due to which plants produced smaller number of capsules.

Fig. 4. Effect of different seed rates on 1000 grain weight (g) of berseem.

1000 grain weight (g)

1000 grain weight is very important yield attributing parameter. The data regarding 1000 grain weight is presented in Fig. 4. Data shows significant difference. Maximum value of 1000 grain weight (898.33g) was noted from the plot where lowest amount (517.67g) of seed was used (10 kg ha^{-1}) while lowest 1000 grain weight was recorded from the plot where seeds were applied @ 25 kg ha^{-1}. Our research findings are similar with the findings of Erdogdu *et al.* (2018) who stated that 1000 grain weight is affected significantly due to seed rate, as seed rate increases the 1000 grain weight decreases. Maximum value of 1000 grain weight (5.78g) was observed in the plot where seed was applied @ 30 kg per ha and lowest 1000 grain weight (5.61g) was recorded at 70 kg per ha seed rate. The research findings are also similar with the findings of Diepenbrock and Porksen (1992); Gubbels and Kenaschuk (1989). The decrease in 1000 grain weight may be due to the fact that the plants received low light and produced low number of capsules and smaller seeds.

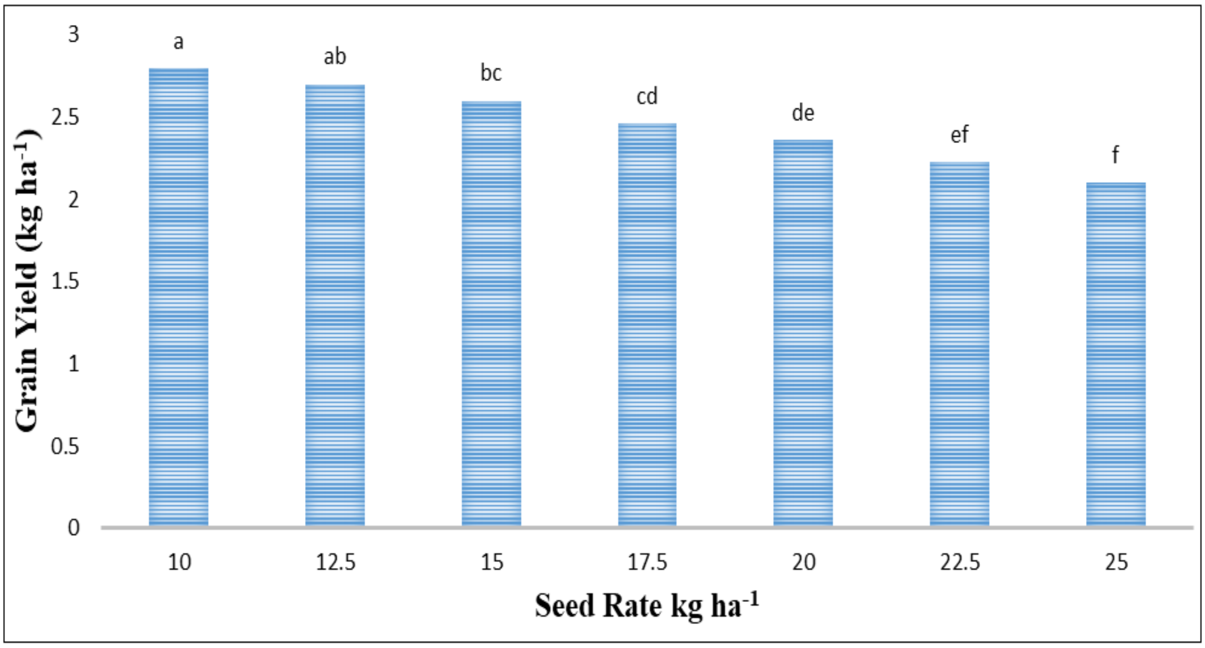

Fig. 5. Effect of different seed rates on grain yield (kg ha^{-1}) of berseem.

Grain yield (kg ha^{-1})

Data related to grain yield is presented in Fig. 5. Data shows that grain yield of berseem was affected significantly due to the different seed rates. Highest value of grain yield (2.8 kg ha^{-1}) was recorded at 10 kg ha^{-1} seed rate which was statically similar (2.7 kg ha^{-1}) with 12.5 kg ha^{-1} while minimum grain yield (2.1 kg ha^{-1}) was recorded from the plot where seeds were applied @ 25 kg ha^{-1}. Our research findings are similar with findings of Kilic and Gursoy (2010) who reported that wheat grain yield was affected significantly due to the seed rate. Maximum yield of wheat grain (5343.2 kg ha^{-1}) was achieved from seed rate of 150 seed m^{-2} while lowest valueof grain yield (5274.0 kg ha^{-1}) was observed at 350 seed m^{-2} seeding rate. Higher yield of grain at lower seed rate might be due to 1000 grain weight and more no. of grains per capsule at lower seed rate. Optimum seedling rate are important to obtain high grain yield (Geleta *et al.*, 2002).

Conclusion

Research findings shows that seed rate of 10 kg ha^{-1} produced the maximum plant height, no. of capsule, no. of seedcapsule^{-1}, seed yield and 1000 grain weight. So, it is recommended that seed rate of 10 kg ha^{-1} is best for maximizing productivity of berseem under agro-climatic conditions of Sargodha, Pakistan.

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