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EFFECT OF DIFFERENT SOWING METHODS AND TIMES ON THE GROWTH AND YIELD OF FENNEL (*FOENICULUM VULGARE* MILL)

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Abstract

A field experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during winter 2003-04 and 2004-05 to evaluate the effect of four sowing methods *viz*., broadcast, line sowing (45 cm), ridge sowing (45 cm) and bed sowing (45/45 cm) on growth and yield of fennel sown on 14th September, 14th October and 14th November 2004. The crop sown in lines gave significantly higher seed yield due to higher number of umbels per plant and number of seeds per umbel. Plant height and biological yield were only influenced during the year 2004-05. The fennel sown on 14th November produced significantly lowest seed yield than 14th September and 14th October mainly due to lower stand density, number of umbels per plant and number of seeds per umbel. The line sowing of fennel in mid October seems to be the best combination for getting higher fennel seed yield.

Introduction

Fennel belongs to the family of Apiaceae and locally is known as saunf. It is grown almost all over the world both as a ornamental and as a seed crop. It can be grown on marginal land and is considered tolerant to various insect pests and diseases. It is well known for having medicinal properties and it is specially used as a remedy measure for flatulence. Although the fennel crop in Pakistan is not grown on commercial scale, yet on account of its medicinal value, the farmers almost all over Pakistan grow on a small scale for their domestic use only. The produce obtained from such small scale cultivation is not sufficient to meet the country requirements and to meet the gap between production and demand. During 2000-01 Pakistan imported 33,768 kg of fennel seed worth Rs. 1.378 million from India (Anon., 2003). So, there is dire need to improve the production of fennel in the country in order to attain self sufficiency in this important commodity. The horizontal expansion is not possible due to the immense pressure of increasing population. So the only viable solution is to increase yield on per unit area basis. As fennel is not cultivated on commercial scale in Pakistan hence many aspects of its package production technology need to be discovered. Among various factors which can increase the yield on per unit area basis, sowing date and sowing methods are considered to be the most important. Leto *et al*., (1996) reported that early sowing produced higher seed yield but oil contents remained similar. The maximum seed yield was obtained when fennel was sown on first fortnight of October (Mohan *et al*., 2001; Yadav & Khurana, 2000).

Maximum genetic potential of the fennel can not be harvested without ensuring the proper sowing method. Transplanting method of fennel gave 38% higher seed yield than direct seeding (Yadav & Khurana, 1999). Ridge sown fennel crop produce higher seed yield than flat sown (Ashiq & Shah, 1993). However, Ashiq (1995) reported that flat sowing produced higher seed yield as compared to ridge sowing.

The information regarding interactive effect of sowing date and sowing methods on growth and yield of fennel is lacking in Pakistan. The present study was, therefore, carried out to evaluate the effect of different sowing dates and methods on growth and yield of fennel under the agro-climatic conditions of Faisalabad, Pakistan.

Materials and Methods

A field experiment was conducted during winter 2003-04 and 2004-05 at Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan to study the effect of broadcast, line, ridge and bed sowing on growth and yield of fennel sown on 14th September, 14th October and 14th November. The experiment was laid out in randomized complete block design with split plot arrangement having three replications and a net plot size measuring 2.7 x 6 m. The sowing times were randomized in main plots and sowing methods in sub-plots. Two seeds were sown at each point in case of ridge and bed sowing and were thinned to one plant per site after germination. Broadcasting was done manually by hand using a seed rate of 5 kg ha^{-1} and single row hand drill was used for line sowing. Sowing on ridges and beds was done with a dibbler. The distance between rows, ridges and beds were kept 45 cm and plant to plant distance of 22.5 cm was maintained in all methods except broadcast. The width of each bed was also kept 45 cm. Entire dose of phosphorus@ 40 kg ha^{-1} was applied at sowing, while, nitrogen @ 75 kg ha^{-1} was applied in two splits i.e., half at sowing and half with first irrigation. All other agronomic practices were kept normal and uniform for all the treatments. For recording plant density an area of 0.81 m^2 was randomly selected at three different places in each plot, plants were counted and were converted to per square meter. Ten plants were selected at random from each plot for recording individual plant observations like plant height, leaf area and number of umbels per plant. For recording number of seeds per umbel, 10 umbels were selected at random from each plot. Three samples of thousand seeds each were selected from the seed lot of each plot for recording 1000-seed weight. The oil contents of seed were determined by using Soxhlet fat extraction methods. Data collected were analyzed using Fisher's analysis of variance technique and least significant difference test at 5% probability level was employed to compare the treatment means (Steel *et al.,* 1997)

Results

Plant density at harvest was significantly affected by different sowing methods in 2003-04 (Table 1) but the effect was not significant in the second year. In 2003-04 the significantly maximum plant density was recorded in broadcast method and minimum in bed sowing method which was statistically at par with line and ridge sowing. However, the effect of sowing date was significant in both the years. The crop sown on 14th September and 14th October produced statistically similar plant density but significantly higher than 14th November during 2003-04. Whereas, during 2004-05 14th September sown crop produced significantly higher stand density than 14th October and 14th November sown crop which in turn remained at par with each other.

Plant height at maturity was not affected significantly by different sowing methods in 2003-04 (Table 1), however, it was influenced significantly in 2004-05. The maximum plant height was recorded with broadcast method and minimum on bed sowing during both the years. The line, ridge and bed sowing produced plants statistically of similar height but significantly lower than broadcast method during 2004-05. The effect of sowing time on plant height was significant in both the years. The crop sown on 14th

September produced plants of maximum height in both the years but it was statistically at par with sowing date of 14th October in 2003-04 whereas, during 2004-05 plant height significantly decreased with delayed sowing. The interaction was not significant.

Leaf area per plant was not affected significantly by different sowing methods in both the years, however, the effect of sowing date was significant (Table 1). The maximum leaf area was recorded when crop was sown on 14th September during both the years. All dates of sowing varied significantly from one another during 2004-05 but the differences between 14th September and 14th October during 2003-04 were not significant. The minimum leaf area was recorded with sowing time of 14th November in both the years.

Number of umbels per plant and number of seeds per umbel were affected significantly by different sowing methods in both the years (Table 1). The maximum number of umbels per plant was recorded in line sowing during both the years and was significantly higher than broadcast, ridge and bed sowing which in turn did not differ significantly from one another. The number of seeds per umbel was also significantly higher in line sowing during both the years. During 2003-04 broadcast, ridge and bed sowing produced statistically similar number of seeds per umbel whereas, all sowing methods differed significantly from one another during 2004-05. Whereas, broadcast, ridge and bed sowing produced statistically similar number of seeds per umbel during 2003-04. The effect of sowing date on number of umbels per plant and number of seeds per umbel was also significant in both the years and all dates of sowing varied significantly from one another in both the years. Maximum number of umbels per plant and number of seeds per umbel were recorded when crop was sown on 14th October in both the years. Significantly minimum number of umbels per plant and number of seeds per umbel were recorded when crop was sown on 14th November in both the years. The interaction between sowing methods and sowing dates was not significant.

Effect of different sowing methods and sowing time on 1000-seed weight of main, primary and secondary umbels and seed oil contents (Table 2) was found to be non-significant in both the years. The interaction was also not significant.

The seed yield of fennel was affected significantly by different sowing methods. The maximum seed yield was recorded when crop was sown in lines in both the years (Table 2). The differences between line and bed sowing were not significant during 2003-04. Similarly broadcast and ridge sowing also remained at par during 2003-04. The line sowing produced significantly higher seed yield than all other sowing methods during 2004-05. The broadcast and bed sowing remaining at par with each other during 2004-05 produced significantly higher seed yield than line and ridge sowing. The effect of sowing time on seed yield of fennel was also significant during both the years. The maximum seed yield was obtained when crop was sown on 14th October and yield was significantly higher than 14th September and 14th November in both the years. The significantly minimum seed yield was recorded when crop was sown on 14th November in both the years. The interaction was not significant.

The biological yield was not affected significantly by different sowing methods in 2003-04 however, the effect of sowing method was significant in second year (Table 2). The crop sown in lines produced the highest biological yield but it was statistically similar to ridge sowing during the year 2004-05. The differences between ridge and bed sowing were also not significant. The minimum biological yield was recorded in broadcast treatment. The effect of sowing time on biological yield was significant during both the years. The crop sown on 14th September and 14th October produced statistically similar biological yield but significantly higher than 14th November during 2003-04. Whereas, during 2004-05 the fennel sown on 14th September produced significantly higher biological yield than 14th October and 14th November. The interaction was not significant.

Seed oil contents were not influenced significantly by both sowing methods and time of sowing. The oil contents ranged between 2.91-2.99% during 2003-04 and it ranged between 2.58-2.76% during 2004-05.

Discussion

Maximum plant density was recorded in broadcast method and minimum in bed sowing, which was statistically at par with line and ridge sowing. The lower plant population in all sowing methods compared with broadcast might be due to the maintenance of plant to plant distance in line sowing by thinning and in ridge and bed method by using dibbler for sowing. Fennel sown on 14th September gave the maximum stand density and lowest stand density was observed when crop was planted on 14th November. Poor germination due to low temperature could have been the cause of low density in late sowing. Mortality of weaker seedlings due o low temperature in late sown crop might have been another reason of lower plant density at harvest.

The broadcast method produced taller plants than all other sowing methods. It might have been due to less plant spacing resulting in greater competition among crop plants for light. Significant effect of sowing methods on plant height has also been reported by Yadav & Khurana (2000). The sowing time significantly affected the plant height and trend was not similar in both the years. The reason for not having the similar trend in both the years could be attributed to variation in the climatic conditions. The decrease in plant height with delayed sowing could be attributed to shorter period of vegetative growth and lower temperature at early growth stages which might have slowed down the vegetative growth of crop plants. Mohan *et al*., (2001) have also reported decrease in plant height with delayed sowing.

The sowing time beyond the 14th September reduced the leaf area per plant. Decrease in leaf area per plant with delayed sowing might have been due to shorter growth period which resulted in lower plant height and less number of leaves per plant.

The differences among sowing methods for number of umbels per plant were significant. Yadav & Khurana (1999) have also reported significant effect of sowing methods on number of umbels per plant and number of seeds per umbel. The minimum number of umbels per plant and number of seeds per umbel in case of late sowing (14th November) might have been due to shorter vegetative growth period, smaller plants and less leaf area which resulted in smaller photosynthetic apparatus and thus less sink (umbels and seeds) was developed accordingly. These results are supported by the findings of Kaya *et al*., (2000) and Mohan *et al*., (2001).

The effect of sowing methods and sowing date was non-significant on 1000-seed weight in both years. As the number of umbels and number of seeds were reduced with delayed sowing so the individual seed weight remained similar. The results are in contrast with those of Chaudhari *et al*., (1995) and Reddy & Rolsten (1999) who reported significant differences among sowing dates for 1000- seed weight. These contradictory results might have been due to climatic variation and genetic traits of the crop plants.

The line sowing produced higher seed yield and this can be attributed to greater number of umbels per plant and number of seeds per umbel. Ashiq & Shah (1993) and Ashiq (1995) have also reported significant effect of sowing methods on fennel seed yield. The results indicated that because of shorter growth period the plants in late sowing were unable to make full use of the available resources which resulted in lower number of umbels per plant and number of seeds per umbel, eventually the lower yield was

obtained. The results are quite in line with those of Mohan *et al*., (2001). They reported that the crop sown during the 1st fortnight of October gave higher seed yield as compared to 15th September, 30th September, 30th October and 14th November sowing. But the results are contradictory to those of Baruah (2001) who obtained maximum seed yield of fennel when crop was sown from 15th September to 1st October. These contradictory results might have been due to difference in climate and genetic makeup of the crop plants.

Sowing methods significantly affected the biological yield during 2004-05. Minimum biological yield was noted in line sowing during both the years. The maximum biological yield in October sown crop can be attributed to greater leaf area, number of umbels per plant and number of seeds per umbel. The results are supported by the findings of Kaya *et al*., (2000) and Yadav & Khurana (2000).

Seed oil contents were not influenced significantly both by sowing date and sowing methods in both the years. Non significant effect of sowing data on seed oil contents of fennel have also been reported by Leto *et al*., (1996) and Kaya *et al*., (2000).

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