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Effects of Sowing Dates and Cultural Treatments on Growth, Quality and Yield of Processing Beans

[1]Funda Yoldas and [2]Dursun Esiyok
[1]Odemis Technical Training College, University of Ege, Odemis, Izmir, Turkey
[2]Department of Horticulture, University of Ege, Bornova, Izmir, Turkey

Abstract: The objective of this study was to evaluate the effect of windbreak and sowing dates on growth and yield of bean varieties; *Amboto*, *Gina*, *Nashau*, *Volare*. Two different treatments of cultural practices (windbreak/no windbreak) were applied all cultivars and sowing dates. The experimental design was a randomized block in a split plot with three replications. Seeds were sown in well prepared soil on 23.07.2004 and 27.08.2004 in 1st year and 29.07.2005 and 29.8.2005 in 2nd year. Results are showed that sowing date, variety and windbreak generally exhibited significant positive influence on growth parameters and yield components. Yield was significantly decreased with later sowing date in all 2 years of research. Significantly better results were obtained in treatments when was used WB. Amboto performed better compared with other three varieties, mostly due to more yield per ha and per plant. Hence, Amboto is recommended for general cultivation of bean and SD_1 was the optimum sowing date of bean for Odemis condition.

Key words: *Bean*, *Phaseoulus vulgaris*, sowing dates, windbreak, cultivar, yield

INTRODUCTION

Bean is an important vegetable which can be used as a seed, fresh and processing industry material. Bean used as human food. It can be used as a vegetable, green and dried, fresh or canned. Bean belongs to family *Leguminaceae*, sub-family *papilionadiae* and genus *glycine*. Legumes are grown on 30.71% of the total cultuvated on 77% of the total legume by taking 1th position (Anonymous, 2004).

Sowing date, ecological factors and cultural practices etc., also influenced the yield and yield characteristics. It's very important to determine most suitable variety and sowing date and use of cultural practices in any region for increase quality and yield. Potential yield of crop can be achieved through optimum use of inputs and agronomic practices. Among the various agronomic practices, optimum sowing date and best variety are of primary importance for potential yield (Amanullah *et al*., 2002). Improvement of processing bean (*Phaseolus vulgaris* L.) for open plot which is wind effect area we have to use windbreak. One of the big problem in autumn production of processing bean is wind which is ecological factor. Wind negatively reduced both quality (shape of bean etc.) and yield of beans. Wind and high temperature stress during flowering and pod filling reduced yield and pod shape which is important a quality property for processing industry Sehirali (1998) Peksen *et al*. (1997) Onder and Senturk (1996) Yaman (1994) Sehirali (1972) Mack and Singh (1969). Wind and high temperature stress was also caused mainly abscission flowers and young pods and it is also caused decrease yield. Especially, when wind factor was imposed during the flowering stage, reduction was greater. Windbreaks add value to acreages in many ways. They reduce wind speed, control snow drifting, provide wildlife habitat, enhance property value and provide pleasant surroundings (Anonymous, 1998). The effectiveness of windbreaks in windspeed reduction is often evaluated without regard to the objects to be protected. In fact, many objects may have different sensitivities to wind and often require different degrees of wind protection (Zhang *et al*., 1995). So, It's very important to determine most suitable sowing date for increase quality and yield. Also, wind factor during especially flowering be affected on yield and pod shape which is important a quality property for processing industry. Therefore, this experiment was undertaken in order to investigate the interactive effects of sowing date, variety, use of windbreak on plant growth, yield and some yield properties of processing bean. Relationships were also investigated between yield and other parameters as affected by some factors so that producers and the bean industry may use them to estimate yield and quality at different sowing dates, variety and use of cultural treatments.

Corresponding Author: Funda Yoldas, Odemis Technical Training College, University of Ege, Odemis, Izmir, Turkey
Tel: + 90 542 322 53 85 Fax: + 90 232 544 43 56

MATERIALS AND METHODS

The present study was carried out in 2004 and 2005 at University of Ege, Izmir, Turkey to find the effect of windbreak and sowing dates on growth and yield of bean varieties; Amboto (Syngenta Seed Company), Gina (May Seed Company), Nashau (Goldenwest Seed Company), Volare (May Seed Company). The experiments were laid out in a split-split plot design with there replications for each plots (Atanasiu, 1968). Main plots were windbreak treatments (1) use of windbreak (plots were surrounded with maize) and non windbreak (2) and sub-plots were the sowing dates, sub-sub plots were varieties. Seeds were sown in well prepared soil on 23.07.2004 (SD_{1-1}), 27.08.2004 (SD_{1-2}) in 1st year and 29.07.2005 (SD_{2-1}), 29.08.2005 (SD_{2-2}) for 2nd year. Each variety was sown in row apart 5 cm with interrow distances of 0.75 m. Chemical and structure properties of the soil were given Table 1.

Throughout the growing period, weeding and other agricultural practices were done whenever necessary (Vural *et al*., 2000). According to soil tests, fertilizers were broadcast each year before sowing. Generally, following each sowing, irrigation was done to obtain a good field emergence. The experiment was irrigated every 4 to 6 days and hand-weeded as necessary. It is well known that the highest quality of green beans is reached before maximum yield (Gardiner and Prendiville, 1970). On each harvest date beans were harvested by hand. Samples of edible parts were collected for measurements and analysis.

At harvest, yield and its components were measured: pod length (cm), seed number of pod (no), yield (kg ha^{-1}), plant height (cm), yield of per plant (kg), dry matter (%) and pod diameter (cm). Dry matter samples of fresh beans were weighed, dried at 70°C for 48 hand re-weighed. Analysis of variance was used to examine the effect of cultivar, sowing date, windbreak, Cultivar×Sowing date (C×SD), Cultivar×Windbreak (C×WB), Sowing date×Windbreak (SD×WB), Cultivar×Sowing date×Windbreak (C×SD×WB) interactions for each year (Table 3). Means were compared using the Least Significant Differences (LSD) at 5-1% level of probability. TARIST computer software package for statistical analyses was used for calculation of analyses of variance (Acıkgoz, 1994).

Table 1: Some physical and chemical properties of experimental soil

Characteristics	Value	Characteristics (Mg kg^{-1})	Value
pH	7.13	NH_4-N	11.20
Souble salt (%)	0.03	Available P	13
$CaCO_3$ (%)	0.33	Available K	90
Sand (%)	79.44	Available Ca	3246
Clay (%)	4.56	Available Mg	120
Loam (%)	16.00	Available Na	10
Texture	Loamy-sand	Available Fe	15.71
Organic M. (%)	1.23	Available Cu	1.80
Total N (%)	0.07	Available Zn	1.26
NO_3-N (Mg kg^{-1})	9.5	Available Mn	10.20

It was the aim of this study to investigate the influence of windbreak and the effect of sowing date on 4 variety beans.

RESULTS

Yield components: The purpose of this study was to determine the optimum sowing dates, varieties of bean under Odemiş condition. In addition, the effect of the use of windbreak on yield and other agronomic characters of the plant were investigated. In all the observed characters (except plant height) statistically significant differences were determined among cultivars and also windbreak treatments (Table 2). Application of sowing dates to cultivars significantly increased all characteristics which are measured; for all cultivars applied with windbreak treatment was higher than the other. Correlation between yield and some growth characteristics were for each combination of WD-SD-V (Table 3). Data regarding mean separation values showed that in response to various cultivars all characters of windbreak, sowing date 1 and 2 were significantly and positively influenced when compared with control. The yield was significantly higher than the control (Table 2). It was also concluded that most of the yield attributes of both SD exhibited highly significant positive correlation with their yield. It's very important to determine most suitable variety and sowing dates in any region for increase quality and yields. In a short-season environment characterized by early spring frost, low night temperatures and dry conditions, appropriate crop duration of which sowing date is an important determinant is essential for successful cropping. In late sowing, yield also decreased because of a short vegetation period. These results agreed the results obtained by Mauromicale *et al*. (1991). Cultivars effect in general was also statistically found significant for both sowing dates.

Some researchers (Chaudhary *et al*., 1989; Rahman *et al*., 2001) reported that yield was increased with a more later sowing dates, which are in contradiction with present findings. Results on various parameters showed that maximum growth and yield was obtained by sowing bean on July. Early sowings increased yields with earliest sowings in 2004 and 2005 yields were obtained when compared to the last sowings (Table 2). Sowing dates effected the all characters (expect pod diameter in 2004) dry matter and pod length were decreased significantly ($p<0.01$ for both years) through the delayed sowings. Early sowing date produced higher yield, plant height but lower pod diameter, dry matter and pod length than the late SD. Confirming the report of Uslu (1998) for soybean. However, WB×SD interaction was not

Table 2: Yield, yield of plant and quality characteristics and significant source of variation for measured parameters of various sowing dates, wind break treatments bean cultivars during 2004 and 2005

Treatments	Pod length (cm)	Seed number in pod (No.)	Yield (kg ha^{-1})	Plant height (cm)	Yield of per plant (kg)	Dry matter (%)	Pod diameter (cm)
2004							
Cultivar (C)							
Amboto	12.67	4.67	12501.0	31.54	175.01	16.16	1.46
Gina	12.90	4.63	11345.0	39.67	158.83	14.75	1.47
Nashau	12.08	5.10	11012.8	28.83	154.18	15.95	1.43
Volare	12.10	4.70	11545.5	34.49	161.64	16.13	1.53
LSD	0.51	0.17	686.0	4.11	9.60	0.73	0.05
Sowing date (SD)							
23.07.2004.	11.13	4.47	11869.3	34.99	166.17	15.33	1.44
27.08.2004	13.75	5.08	11332.9	32.28	158.66	16.16	1.50
LSD	0.35	0.13	339.3	1.95	4.75	0.36	0.03
Windbreak treatment (WB)							
Windbreak	12.52	4.75	11646.4	34.96	163.05	16.40	1.54
No Windbreak	12.36	4.80	11555.8	32.31	161.78	15.09	1.41
LSD	NS	NS	NS	1.95	NS	0.37	0.03
2005							
Cultivar (C)							
Amboto	12.65	5.13	12049.8	33.90	168.70	6.81	1.52
Gina	12.02	4.84	11481.3	40.68	160.74	7.26	1.42
Nashau	12.13	5.79	11761.4	30.83	164.66	7.44	1.46
Volare	12.58	4.73	12128.3	36.12	169.79	7.94	1.45
LSD	NS	0.27	355.0	3.29	4.97	0.13	0.05
Sowing date (SD)							
29.07.2004	11.71	5.21	12783.7	37.00	178.97	7.72	1.47
29.08.2004	12.98	5.04	10926.7	33.76	152.97	7.01	1.46
LSD	0.50	0.14	437.7	2.22	6.13	0.08	NS
Windbreak treatment (WB)							
Windbreak	12.72	5.29	12413.8	36.45	173.79	7.65	1.52
No Windbreak	11.97	4.96	11296.6	34.31	158.15	7.08	1.41
LSD	0.50	0.14	437.7	1.63	6.13	0.08	0.03

NS: Nonsignificant

Table 3: Significant source of variation for measured parameters

Interaction	Pod length (cm)	Seed number in pod (No.)	Yield (kg ha^{-1})	Plant height (cm)	Yield of per plant (kg)	Dry matter (%)	Pod diameter (cm)
2004							
C	**	**	**	**	**	**	**
SD	**	**	**	**	**	**	**
WB	NS	NS	NS	**	NS	**	**
C×SD	**	**	**	NS	**	**	**
C×WB	**	**	**	**	**	**	**
SD×WB	NS	**	**	NS	**	**	**
C×SD×WB	**	**	**	NS	**	**	**
2005							
C	NS	**	*	**	*	**	**
SD	**	**	**	**	**	**	NS
WB	**	**	**	*	**	**	**
C×SD	*	*	**	NS	**	**	**
C×WB	*	**	**	*	**	**	NS
SD×WB	NS	**	**	NS	**	NS	NS
C×SD×WB	**	**	**	NS	**	**	**

NS: Nonsignificant difference; *: The difference is significant at the 95 (%) level; **: The difference is significant at the 99 (%) level

statistically significant on pod length and plant height. The variety and windbreak treatments were the main explanatory factor in the experiment. Results also revealed that the response of yield attributes in relation to use of WB were found highly significant in SD_1 and non significant in SD_2. In the first year, windbreak did not effect significantly the characters studied expect for plant height, dry matter, pod diameter which have significant differences were obtained. But in the second year, this treatment affected significantly the characters. Wind and high temperature stress during flowering and pod filling reduced yield and pod shape which is important a quality property for processing industry, character of bean. Wind and high temperature stress was also caused mainly abscission flowers and young pods and it is also caused decrease yield. When wind was imposed during the flowering stage, the reduction was greater. So, mean bean yield was the highest at windbreak and the lowest at no

windbreak plots (Table 2). Therefore the data suggested that neither various windbreak alone nor in combination with sowing date did significantly affected the pod length. But sowing date did significantly affect the plant height in 2004. Significantly better results were obtained in treatments when was used WB. NWB did not adversely affect the plant growth and yield of bean. Yield was significantly higher at WB than NWB for both years, a differences of 0.1-0.9%, respectively. Treatment effect was noted as highly significant and windbreak produced maximum yield (11646.4 kg ha^{-1}) followed by no windbreak (11555.8 kg) in first year. In completion of the study, the highest yield was 12413.8 kg ha^{-1} from WB field/plot. The lowest yield of 11296.6 kg ha^{-1} was obtained from NWB plots in the second year. This result showed similarity to the findings of Meinke *et al*. (2002a) who reported that, assuming a 70% reduction in wind speed as representing the maximum potential windbreak effect, the average yield improvement for the Queensland site was 13% for wheat and 3% for mungbean. Also, Tunisian researchers have shown that, windbreaks can increase the yield of vegetable and fodder crops by 17-100%, depending on the crop and local conditions (Anonymous, 2006). The another research reported that, windbreaks provided protection against all wind, when wind protection from all directions is assumed, average simulated yield increases ranged from 0.2% for maize and 24.6% for wheat (Meinke *et al*., 2002b). Puri *et al*. (1992) reported that, increase in cotton yield was found to be 4 to 10% plant growth and yield were observed to be high in sheltered area as compared to open fields. Genotype had a much larger influence on bean quality parameters than did WB.

Planth height (cm): Results are showed that sowing date, variety and windbreak generally exhibited significant positive influence on growth parameters (Table 2 and 3). Treatments exhibited significant influence on growth parameter (plant height) of early sowing dates. Average plant height was changed between 25.70 to 49.00 cm depending to the years and treatment combinations. Research revealed that bean cvs being a taller genotype produces taller plants when sown early. July sowings were similar in plant height for both years, but they gave taller plants than August sowing (Table 2). Sowing dates affected the plant height and they were decreased significantly through the delayed sowings (Uslu, 1998). There was difference of more than 5 cm between late July and late August. These decreases in plant height could be attributed to a shorter vegetative period. On the other hand, cultivar also significantly affected the plant height (Table 2). Nashau gave slightly lower plant height for both years (28.83, 30.83 cm, respectively) compared to other cultivars. The cultivar Gina was the tallest (39.67, 40.68 cm, respectively) compared to the other three cultivars.

CONCLUSION

The data presented above indicated that, there was a yield advantage to sowing beans at the Odemis condition as possible, i.e., in late-July. Late sown beans will mature around early October or late October is not suitable for the region because of unfavorable harvest weather conditions. In addition, rainy days after mid-September may be hazardous for the quality and yield. When sowing is delayed until the end of August, the yield will decreased significantly. Late sown beans will mature around late (October or November) are not suitable for the region because of unfavorable harvest weather conditions. WB or non WB does not in itself result in better bean quality or weight as compared with WB or NWB parcels, but its advantages are mainly of an ecological nature. As a result, windbreaks improve the quality of bean. Amboto was determined as high yielding cultivar under Western Anatolia Region irrigated conditions. Amboto is recommended for general cultivation of bean and SD_1 was the optimum sowing date of bean for Odemis conditions (latitude 38° 16′ N, longitude 27° 59′ W) which located surrounding of Kucuk Menderes River in the Western Turkey has a suitable place for bean production. The results indicated that beans should be sown in late July and with windbreak to achieve high yields.

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