

In the name of Allah

NOTE

VARIABILITY OF YIELD AND OTHER  
PLANT CHARACTERISTICS OF BARLEY  
UNDER IRRIGATED AND RAINFED  
CONDITIONS<sup>1</sup>

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ABSTRACT

Single-head seeds from 450 winter barley (*Hordeum vulgare* L.) lines were planted in 1-m rows in two adjacent fields at the Kooshkak Agricultural Experiment Station. Similar moisture tension existed at both fields until April 12. One field, designated as the irrigated nursery, received four irrigations during the growing season; while the other field was not irrigated. In both fields, maximum variability was observed for lodging percentage, with grain yield per plot next in order. Except for lodging percentage, initiation of heading to 80% heading, initiation of heading to soft dough stage and initiation of heading to ripening, the differences between the coefficients of variability (C.V.) under rainfed and irrigated conditions did not surpass 6%. Rainfed conditions decreased the mean value of grain yield, harvest index, straw weight, seed set percentage, lodging, plant height, and periods of various ripening stages.

INTRODUCTION

In Iran barley, which is mainly grown for feed, ranks second after wheat in acreage. Barley acreage was 1.48 million

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بنام خدا  
تغییرات عملکرد و سایر صفات جو در شرایط  
کشت آبی و دیم  
محمد رضا مصطفوی و منصور نیک نژاد  
بترتیب مربی و دانشیار بخش زراعت  
دانشگاه شیراز

خلاصه

بذورتک خوشه ۴۵۰ رقم جوز مستانه بر روی خطوط یک متری در دو قطعه زمین مجاور یکدیگر در ایستگاه تحقیقاتی کوشکاک کاشته شدند. شرایط رطوبتی در دو قطعه ۲۳ فروردین برای هر دو قطعه یکسان بود و از آن به بعد یکی از قطعات در طول فصل رشد چهار بار آب دریافت کرد در حالی که قطعه دیگر آبیاری نکردید. در هر دو قطعه حداکثر تغییرات برای درصد خوابیدن بوته ها مشاهده شد و پس از آن مقدار عملکرد را کم از حداکثر تغییرات بر خورداری بود. با استثنای درصد خوابیدن، شروع تا ۸۰ درصد خوشه رفتن، خوشه رفتن تا رسیدن بذریه مرحله خمیری نرم و خوشه رفتن تا رسیدن کامل بذر، اختلافات بین شرایط تغییرات در شرایط آبی و دیم از ۶ درصد تجاوز نکرد. شرایط دیم باعث کاهش متوسط عملکرد، ضریب برداشت، وزن کاه، درصد تشکیل بذر، خوابیدن بوته، ارتفاع نبات و طول دوره مراحل مختلف رسیدن، گردید.

hectares in 1976 with an average yield of 1010 kg/ha (2). About 67% of the crop was grown under rainfed conditions and the rest was irrigated.

Iran has a good potential for increasing barley production under both irrigated and rainfed conditions. However, local barley cultivars do not show favorable responses to improved cultural practices requisite to increased yields.

*Responses of various barley cultivars to specific or general environmental conditions* have been studied by many investigators. Andrushchenko (1), Conti and Ferraresi (5), Pande *et al.* (9) and Sharma *et al.* (13) worked on different collections of barley lines and found a considerable amount of variability for different plant characteristics. Bauer *et al.* (4), Day and Thompson (6), Kaminiska and Mazalaska (7), Lazarov (9), and Schreiber and Stanberry (11) found that, in general, low moisture tension in barley resulted in increased grain yield, shorter plants, and more lodging.

In spite of rather extensive literature dealing with the effects of various irrigation regimes and water stress on the variability of different characteristics of barley lines, such information is lacking for barley growing areas of Iran in general and for the Fars province in particular. The present investigation was aimed at obtaining such information to provide the breeders with proper criteria for effective planning of their barley breeding programs when selecting for drought resistant genotypes.

#### MATERIALS AND METHODS

Seeds of 450 winter barley (*Hordeum vulgare* L.) lines, originally collected from various regions of Iran or introduced from abroad were used in this study. Lines were reproduced by single head selection for at least five successive selfing generations and thus could be regarded as pure lines. From each line, heads were threshed separately and planted in a one-meter row in irrigated and rainfed nurseries with

rows 75 cm apart. The experiment was carried out at the Kooshkak Agricultural Experiment Station, 75 km northwest of Shiraz, Iran, an alluvial plain with a very heavy-textured soil. The water table in this area is usually high (1.5-2.5 m) throughout the year and the capillary fringe varies from 50 to 75 cm. The water quality is good for irrigation.

Plots were harvested on June 10, 1978. Characteristics such as days to different growth and developmental stages, plant height, lodging percentage, grain yield, straw weight, harvest index [(grain yield/biological yield) X100], head length, number of seeds per head, and seed set percentage were recorded separately for each line.

#### RESULTS AND DISCUSSION

Range, mean, standard error and coefficient of variability (C.V.) for different plant characteristics are presented in Tables 1 and 2. A considerable amount of variability existed in all the characters of the materials studied under both moisture conditions. This is, in general, consistent with result obtained by others on collections of barley and wheat cultivars (1, 3, 5, 9, 10, 12, 13).

Trends of coefficients of variability for various characteristics studied were similar under both irrigated and rainfed conditions. Maximum variability was obtained for lodging percentage under both conditions. This could be attributed to the fact that the collection contained both highly lodging-resistant and susceptible lines and favorable field conditions permitted their full expression. However, the calculated C.V. for lodging under dryland conditions turned out to be greater than that under irrigated conditions (Table 1). This could, probably, be due to the fact that dispersions, as measured by standard deviations or standard error, under both conditions for this character were almost equal while the mean for lodging percentage

Table 1. Mean, standard error, range, and coefficient of variability (C.V.) for agronomic characteristics of 450 different barley lines under irrigated and rainfed conditions.

| Character                  | Mean $\pm$ S.E.   |                   | Range        |              | C.V. (%)  |         |
|----------------------------|-------------------|-------------------|--------------|--------------|-----------|---------|
|                            | Irrigated         | Rainfed           | Irrigated    | Rainfed      | Irrigated | Rainfed |
| Grain yield (g)            | 317.0 $\pm$ 7.62  | 256.4 $\pm$ 5.82  | 10-710       | 10-630       | 51.0      | 48.1    |
| Harvest index <sup>†</sup> | 26.9 $\pm$ 0.50   | 25.2 $\pm$ 0.48   | 2- 62        | 1- 50        | 39.1      | 40.3    |
| Straw weight (g)           | 829.6 $\pm$ 12.34 | 736.9 $\pm$ 10.30 | 230-1710     | 90-1590      | 31.6      | 29.6    |
| Lodging (%)                | 41.3 $\pm$ 1.81   | 27.7 $\pm$ 1.66   | 0- 100       | 0- 100       | 93.2      | 127.2   |
| Plant height (cm)          | 106.3 $\pm$ 0.52  | 105.0 $\pm$ 0.59  | 85- 135      | 65- 135      | 10.3      | 12.0    |
| Head length (cm)           | 7.1 $\pm$ 0.33    | 7.0 $\pm$ 0.09    | 3.20- 13.33  | 3.11- 13.75  | 25.7      | 28.5    |
| Seeds/head                 | 47.4 $\pm$ 0.77   | 46.2 $\pm$ 0.67   | 15.44- 85.11 | 18.80- 80.60 | 34.2      | 31.0    |
| Seed set (%)               | 84.4 $\pm$ 0.54   | 80.0 $\pm$ 0.04   | 34.11- 100   | 43.81- 100   | 13.6      | 17.8    |

<sup>†</sup> (Grain yield/biological yield)  $\times$  100.

Table 2. Mean, standard error, range, and coefficient of variability (C.V.) for different growth and developmental stages of 450 different barley lines under irrigated and rainfed conditions.

| Character <sup>†</sup> | Mean $\pm$ S.E.  |                  | Range     |         | C.V. (%)  |         |
|------------------------|------------------|------------------|-----------|---------|-----------|---------|
|                        | Irrigated        | Rainfed          | Irrigated | Rainfed | Irrigated | Rainfed |
| Days to HDG            | 158.8 $\pm$ 0.31 | 150.6 $\pm$ 0.69 | 149-180   | 118-117 | 4.2       | 9.8     |
| Days to 80% heading    | 166.4 $\pm$ 0.31 | 161.8 $\pm$ 0.53 | 154-188   | 143-188 | 3.9       | 6.9     |
| Days to SDS            | 177.6 $\pm$ 0.40 | 172.1 $\pm$ 0.49 | 165-197   | 152-192 | 4.8       | 6.7     |
| Days to HDS            | 187.6 $\pm$ 0.42 | 186.9 $\pm$ 0.47 | 174-207   | 171-207 | 4.8       | 5.3     |
| Days to ripening       | 194.8 $\pm$ 0.44 | 192.5 $\pm$ 0.43 | 199-212   | 175-211 | 4.8       | 4.7     |
| HDG to 80% heading     | 7.5 $\pm$ 0.10   | 11.3 $\pm$ 0.29  | 3- 15     | 3- 44   | 28.7      | 54.3    |
| HDG to SDS             | 18.8 $\pm$ 0.19  | 21.5 $\pm$ 0.31  | 11- 32    | 5- 57   | 21.5      | 31.0    |
| HDG to HDS             | 28.8 $\pm$ 0.24  | 36.1 $\pm$ 0.36  | 20- 44    | 19- 67  | 17.8      | 21.0    |
| HDG to ripening        | 35.9 $\pm$ 0.26  | 41.8 $\pm$ 0.38  | 24- 49    | 25- 73  | 15.4      | 19.5    |
| SDS to HDS             | 10.0 $\pm$ 0.13  | 14.7 $\pm$ 0.16  | 5- 16     | 6- 23   | 26.7      | 23.5    |
| SDS to ripening        | 17.1 $\pm$ 0.16  | 20.3 $\pm$ 0.18  | 9- 28     | 11- 31  | 20.1      | 19.3    |
| HDS to ripening        | 7.1 $\pm$ 0.10   | 5.6 $\pm$ 0.12   | 3- 15     | 2- 15   | 31.1      | 43.4    |

<sup>†</sup> SDS = Soft dough stage, HDS = Hard dough stage and HDG = Initiation of heading.

under dryland conditions was much less than that under irrigated conditions.

Except for lodging percentage, initiation of heading to 80% heading, initiation of heading to soft dough stage, and initiation of heading to ripening, for which the variability was great under rainfed as compared to irrigated conditions, the differences between the C.Vs. under the two conditions did not surpass 6% (Tables 1 and 2).

By comparing the mean values in Tables 1 and 2, it is evident that moisture deficiency decreased grain yield and other plant characteristics such as harvest index, straw weight, seed set, lodging, plant height, days to initiation of heading, days to 80% heading, days to soft dough stage, and days to ripening. The results are consistent with those of Bauer *et al.* (4), Day and Thompson (6), Kaminiska and Mazalaska (7), Lazarov (8), and Andrushchenko (1). In the present experiment, number of seeds per head was not different under the two conditions while Andrushchenko (1) found irrigated plants produced 29% more seeds per head. This inconsistency may be a reflection of a high water table in both irrigated and non - irrigated plots at the site of the present experiment, which supplied the plants with sufficient moisture at flower initiation stages. Furthermore, an increase of 23.64% in grain yield per plot was observed under irrigated as compared to rainfed conditions, whereas Andrushchenko (1) reported 75% increase for irrigated plots. This comparatively low yield increment could be explained on the basis of the fact that the rainfed plants did not suffer from lack of available water throughout most of their growth period as was also witnessed by the field appearance of the plants. In addition to the high water table, about 581 mm of rain fell during the fall and winter seasons.

The results presented herein may aid barley breeders to select proper criteria in their breeding programs when

breeding for drought resistant genotypes.

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