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NOTE

ANALYSIS OF PHYTOMASS IN 36 IRANIAN WINTER WHEAT (*Triticum aestivum* L. em. Thell.) GENOTYPES

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ABSTRACT

Wheat (*Triticum aestivum* L. em. Thell.) grain yield shows high genotype-environment interaction, and thus a slow response to direct selection for yield. Selection criteria other than grain yield (i.e., harvest index) are being sought by wheat breeders. Further improvement in harvest index appears difficult and future increases in grain yield may have to come through increases in phytomass production. A study was conducted to investigate the association between harvest index and phytomass of single plants and plot grain yield. A considerable diversity was found among 36 cultivars of Iranian wheat genotypes for these traits. More variation was found in phytomass than harvest index. However, harvest index was

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found to be the most stable trait giving the highest correlation with plot grain yield. It was concluded that harvest index of single plants is a suitable predictor for yielding ability where the available seed for yield study is limited, and is a potential criterion in selection indirectly for increased grain yield in Iranian wheat genotypes.

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تجزیه و تحلیل میزان کل ماده خشک در ۳۶ ژنوتیپ گندم ایران

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چکیده

گزینش مستقیم برای عملکرد دانه درگندم نان به دلیل اینکه عملکرد به شدت تحت تاثیر متقابل محیط و ژنوتیپ گیاه قرار دارد، با موفقیت چندانی همراه نبوده است. به همین دلیل یافتن معیارهایی بجز عملکرد دانه (نظیر شاخص برداشت) که گزینش آن ها سبب افزایش هر چه سریعتر و موفقیت آمیزتر عملکرد شود ذهن بهنژادگران را به خود مشغول داشته است. به نظر می رسد که افزایش بیشتر عملکرد دانه از طریق افزایش شاخص برداشت کاری دشوار باشد زیرا شاخص برداشت در ارقام نوین امروزی به حداکثر ممکن خود نزدیک شده است. مطالعات انجام شده

نشانگر این است که در طی روند اصلاح گندم با افزایش شاخص برداشت، میزان کل ماده خشک گیاه ثابت باقی مانده است و از این رو، این صفت ممکن است معیار مناسبی جهت افزایش عملکرد دانه باشد. در بین صفات مورد بررسی در تک بوته های این ژنوتیپ ها، میزان کل ماده خشک تولیدی دارای بیشترین ثبات و بزرگترین همبستگی با عملکرد دانه می باشد. بطور کلی می توان چنین نتیجه گرفت که شاخص برداشت تک بوته گندم های ایرانی در شرایط اکولوژیکی کشور، در مواردی که جهت مطالعات با کمبود بذر مواجه باشیم، وسیله مناسبی جهت پیش بینی عملکرد بالقوه گندم بوده و این صفت در گندم های ایرانی هنوز معیاری بالقوه مناسب برای گزینش غیر مستقیم عملکرد می باشد.

INTRODUCTION

Grain yield is inherited in a complex manner (5). The growing interest in selecting for traits other than yield in plant breeding projects is motivated by the difficulties inherent in selecting directly for grain yield. Since the introduction of "harvest index" by Donald (6), its importance and usefulness as a selection criterion for improving grain yield in cereals have been appreciated (e.g., 3, 7, 8, 10, 11, 13, 17, 19).

In fact, increase in wheat yield has been achieved through improvement in harvest index, without much improvement in phytomass production (2,14). Recent studies, however, led to the conclusion that modern wheat cultivars show variation in phytomass, and there is a scope for improving this trait (14, 15, 18).

Most investigators have obtained positive correlations between phytomass and grain yield in wheat (e.g., 13), and while some reported a negative relationship (e.g., 1, 4, 9, 10, 14, 15, 16), Sharma (16) suggested that grain

yield in cereals may be increased by improving phytomass at a given level of harvest index. Austin (2) also showed that an alternative for ahieving increased grain yield is to increase the total dry matter produced by the crop.

Measurements on spaced plants, which could reliably predict yielding ability of genotypes when seeded at commercial densities, would be very useful (8).

The main objectives of this study were to determine some important single plant characters which could be used as criteria in selection for high plot grain yield and to determine the diversity and stability for harvest index and phytomass in 36 Iranian winter wheat genotypes.

MATERIALS AND METHODS

A field experiment was conducted during the 1992-1993 growing season at the Agricultural Experiment Station of Shiraz University at Badjgah, 1810 m above sea level, longitude 52°32′ E and latitude 29 °36′ N. Thirty six cultivars of wheat, developed at the Fars Agricultural Research Center, were used in this study.

Prior to planting, the field was first plowed with a moldboard plow to a depth of 30 cm. Nitrogen was added at a rate of 94 kg ha^{-1} (as 120 kg urea and 200 kg diammonium phosphate ha^{-1}) and phosphorous at a rate of 47 kg ha^{-1} (200 kg diammonium phodphate ha^{-1}) before planting and mixed with soil. The sowing date was 5 November 1992. Each cultivar was sown in a 3-m long row and the rows were spaced 50-cm apart, in a randomized complete block design with three replicates. Weeding was performed by hand with no herbicide application. Plants did not suffer from moisture stress during the growing period. Each plot was harvested by hand at maturity and processed for grain yield and its components.

Table 1. Mean, range, and standard deviation (SD) of studied characters.

Characters	Mean	Range	SD
Plot grain yield (ton ha^{-1})	2.55	1.15-3.93	0.64
Single plant grain yield (g)	21.93	8.34-48.6	7.08
Single plant non-grain yield (g)	38.16	16.75-53.6	10.65
Single plant harvest index (%)	41.01	19.5 -54.86	8.20
Single plant phytomass (g)	60.16	28.8 -94.74	14.98

Four characters (Table 1) were selected to determine their possible association with grain. Coefficient of variation for each variable among all cultivars (CV1), mean coefficient of variation for each variable within cultivars (CV2), the mean of 36 coefficients of variation for each character which is an indicator of the stability of each character, and correlation among phytomass, non-grain yield, harvest index,plot grain yield, and spaced plant grain yield were computed.

All statistical analyses were conducted using SPSS (statistical package for the social science) microcomputer program (12).

RESULTS AND DISCUSSION

As expected, a considerable diversity (CV1) was found among cultivars for all the studied characters (Table 2). A small value for CV2 (in Table 2) for a trait may indicate the stability of that character under experimental conditions.

Table 2. Coefficient of variation of each variable among all cultivars (CVI) and mean coefficient of variation of each character for each cultivar (CV2).

Character	CV1	CV2
Plot grain yield	25.00	20.95
Single plant grain yield	32.28	15.74
Non-grain yield	27.92	19.16
Harvest index	20.00	8.54
Phytomass	24.90	14.01

On the basis of magnitude of CV2 in Table 2 the five studied characters could be categorized as:

$25 \leq CV2$	extremely unstable
$20 \leq CV2 < 25$	highly unstable
$15 \leq CV2 < 20$	unstable
$10 \leq CV2 < 15$	moderately stable
$5 \leq CV2 < 10$	stable
$CV2 < 5$	highly stable

According to this classification, harvest index was considered the most stable trait, while plot grain yield was the least stable. In this experiment harvest index was found to be stable, phytomass moderately stable, and non-grain yield and single plant grain yield were unstable.

Previous studies have also shown that increase in grain yield of wheat genotypes developed over past several decades has been associated with improved harvest index without much improvement in phytomass production (3).

Recent studies (e.g., 14) indicate that recently released wheat cultivars show variation in phytomass production. The result of this study also confirmed that wheat genotypes examined show considerable variation in phytomass production partitioned into non-grain and grain yield (Table 2). This indicates the potential in increasing phytomass for improving grain yield.

There were highly significant positive correlations between single plant grain yield and phytomass production, phytomass and non-grain yield (Table 3). A significant positive correlation was also found between single plant grain yield and non-grain yield. These results are in agreement with those obtained by Sharma (16 in intensive planting, and Syme (17), who reported a positive correlation between single plant grain yield and non-grain yield.

Table 3. Simple correlation coefficient of variables.

Variable	SPGY	NGY	PM	HI	PGY
Single plant grain yield (SPGY)	1	0.36*	0.75*	0.27	0.37*
Non-grain yield (NGY)		1	0.89**	-0.42**	-0.31
Phytomass (PM)			1	-0.17	-0.04
Harvest index (HI)				1	0.82**
Plot grain yield (PGY)					1

*,** Significant at the 5% and 1% levels of probability, respectively.

Harvest index of single plant offers a suitable predictor for yielding ability where the available seed is limited. The stability of harvest index (Table 2) and positive correlations with plot grain yield (Table 3), indicate

that harvest index might be a potenial criterion in selecting indirectly for increased grain yield in winter wheat.

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