Investigation of the relationship between grain yield and quantitative traits in Tritipyrum, a new salt tolerant amphiploid, in comparison with Triticale and Iranian wheat by factor analysis

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ABSTRACT

There are different characteristics which are used as selection criteria to determine the potential of different lines and cultivars. Tritipyrum, a new salt tolerant amphiploid, is the third handmade cereal after Triticale and Tritordeum. To study the superior characters of this crop (13 lines) in comparison with Triticale (5 lines) and Wheat (14 cultivars) for cultivating in saline soil and to determine the relationship among grain yield, its components and morphological characters, three different statistical methods including, comparison of means, factor analysis and coefficient correlation were used. Cluster analyses also were used to classify cultivars and lines. The results revealed that the grain yield of all these three amphiploids correlated with chaff weight, biological yield, number of grain per spike, plant length and number of spikelet per spike, while Tritipyrum also showed a positive correlation for flag leaf length, number of spikes and tillers. Based on factor analysis 4 factors were determined for Triticale and 5 factors for wheat and Tritipyrum. These factors were mentioned as effective factors on the source, sink and plant height. Cluster analysis categorized the genotypes in four groups. The highest amount of grain yield was belonging to the group which involves Tritipyrum lines.

INTRODUCTION

The lands under salt stress are extensive in area. These lands consist about 25% of whole lands in the world (Tangy and Kid, 1995). Two ways were suggested for cultivation in these lands and using saline waters, first planting tolerant genotypes in this lands and the second using of different breeding program to make tolerant genotypes. Nowadays, wheat is a staple food for humans and it supplies more than 20 percent of calories for humans in the world (Calaghet, 1984; Anderson and Kempthorn, 1965), so plant improvement for making new salt varieties is very important. One of these new salt tolerant varieties is Tritipyrum, that is derived from bread wheat ×Thinopyrum bessarabicum. Tritipyrum can survive in salt concentration around 250 mmol NaCl. In this amphiploid, traits including salt tolerance, continuous tillering and perenniality, have made it a superior plant for saline soil and/or saline water (King, 1997; Hassani 2002). Therefore this plant could be a new opportunity for enhanced salt tolerance and studying its superior characteristics are necessary. The aim of this study was to compare Tritipyrum with Triticale and Iranian wheat.

MATERIAL AND METHOD

The field experiment was conducted at the experimental farm of Shahid Bahonar university of Kerman, Iran in the 2005 growing season based on a Randomized Complete Block design (RCB) with three replications. In this experiment 13 Tritipyrum lines (Ka/b ‹St/b ‹AZ/b ‹ Cr/b‹La/b‹ La(4b/4d)b,Cs/b, Ma/bxCr/b,F4. Ma/bxCr/b,F3‹ Ka/bxcr/b,F2, Ka/bxcr/b,f 3, Ka/bxcr/b,f 5 ‹Ka/bxcr/b,f6 ‹ St/bxCr/b,f4), 4 Triticale lines (4116, 4115, 4103, 4108, M45) and 14 Iranian wheat cultivar (Omid, Alvand, Bahare baft, Niknejad, Roshan, Kavir, M757, Double haploide, Catlicum, Stewart, Creso) were used. In each plot (2.5 m^2), 50 g seed were planted and during the growing season, morphological traits (flag leaf length and width, plant length, awn length, date of ear emergence, ear emergence period, date of pollination, pollination period, life cycle, number of tiller and ear, percentage of ear fertility, ear length, grain length, number of spiklet in ear, number of grain in ear, number of grain in spiklet, weight of 1000 grain, chaff weight, biological yield and harvest index) and grain yield of 20 plants of each plot was measured.

RESULTS AND DISCUSSION

Significant differences ($P<0.05$) were observed among genotypes for all of the traits, except percent ear fertility. Comparison of the means in different traits indicated that the amphiploid was superior in each trait. In Tritipyrum, correlation coefficients showed that grain yield had a significant and positive correlation with tiller number (r=0.557), ear number (r = 0.544) and weight of 1000 grain (r = 0.597) and the highest correlation coefficient belonged to chaff weight and biological yield (r = 0.973). In wheat, grain yield correlated with number of grain in spikelet (r = 0.607), number of grain in the ear (r = 0.611) and weight of 1000 grain (r = 0.622), and the higher correlation coefficient were among ear appearance and pollination initiation. In Triticale, there was a positive and significant correlation between yield with plant height (r = 0.939) and number of spikelet per ear (r = 0.911) and a higher correlation coefficient between chaff weight and biological yield (0.998). On the other hand grain yield in each of amphiploids was correlated with different components, so we could suppose that the most important grain yield components in grain yield were specific to genotypes.

Factor analysis by using of 22 agronomical traits was done for Wheat, Triticale and Tritipyrum, separately. In Wheat, 5 factors were recognized. Factor 1 was strongly associated with length and width of flag leaf, date of ear emergence, ear emergence period, date of pollination, pollination period, percentage of ear fertility and life cycle. This factor was regarded as a relationship between sink and source factor. Factor 2 was a productivity factor and was made up of plant height, number of tillers and ears, weight of 1000 grain, grain yield, chaff weight and biological yield. Factor 3 was called a capacity of sink and source factor because of it consisted of length of grain and awn. Factor 4 consisted of number of spikelets per ear, number of grain per ear and number of grain in spikelet. This factor could be considered a sink capacity factor. Finally factor 5 was made up of ear length and harvest index. This was called a transforming potential factor.

In triticale, we distinguished 4 factors. Factor 1 concerned plant length, ear emergence period, and ear length, number of spikelet per ear, number of grain per ear, grain length, chaff weight, grain width and biological yield and called a productivity factor. Length and width of flag leaf, awn length, date of ear emergence, and date of pollination, number of grain in spikelet and harvest index were placed in factor 2 and were the relationship between sink and source factor. There are traits including life cycle, fertilizing ear percentage, weight of 1000 grain, grain length, pollination period in factor 3 and this factor could be considered a sink capacity factor. Factor 4 was associated with number of tillers and ears. This factor was regarded as a potential of tiller producing factor.

In Tritipyrum 5 factors were distinguished, factor1: width flag leaf, time of ear appeared, date of pollination, pollination period, life cycle, ear fertilizing percentage, ear length, grain length, number of grain in ear, factor 2: number of tillers and ears, grain yield, chaff weight, biological yield, factor 3: awn length, number of grain per spikelet, weight of 1000 grain, factor 4: flag leaf length, harvest index, and factor 5: plant length. Factor 1 was called the relationship between sink and source factor and factors 2 and 3 were considered as productivity and sink capacity factors, respectively. Factor 4 could be considered a transforming potential factor and also factor 5 was called a plant height factor.

Cluster analysis was done and genotypes were categorized in 4 groups, each of which included different genotypes, the first group: Ka/bxcr/b,F2, Cs/b, Ka/bxcr/b,F 3, AZ/b, Ma/bxCr/b,F3, La(4b/4d)b, St/bxCr/b,f4, the second group: Ka/b, Ma/bxCr/b,F3, Cr/b،La/b, Ka/bxcr/b,f 5, Ka/bxcr/b,f6, the third group: Triticale 4108, Triticale 4115, Triticale4103, Triticale M45 and finally the fourth group: wheat cultivar (Omid, Alvand, Roshan, Double haploid, Niknejad, Kavir, M757, Bahare baft, M7510, Cathlicum, Stevart, Azizia, Cerso), Triticale 4116, St/b. The lines in these groups had significant differences in whole measured traits.

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