



Seed 2024



Al-Qasim Green University



Razi University



Iranian Seed Scientific Association



Iranian Seed Scientific Association



Iranian Seed Scientific Association

The 2nd International Seed Science and Technology Conference of Iran

“Seed 2024”

(Medicinal Plant, Crop, Horticulture, Pasture & Forest)



CIVILICA



ISC

seed2024.razi.ac.ir

Application of image analysis in DUS test: A case study in Triticale

Zahra Eshkil Gandomani ¹, Reza Tavakkol Afshari ^{2*}, Mehdi Rastgoo ³,
Mohammad Reza Jazayeri ⁴ & Seyyed Mohammad Seyyedi ⁵

¹Department of Agrotechnology, Faculty of Agriculture, Ferdowsi University of Mashhad, Iran

²Ph.D. Department of Agronomy & Plant Breeding Ferdowsi University of Mashhad

³Ph.D. Department of Agrotechnology & Agriculture Ferdowsi University of Mashhad, Iran.

⁴ Seed and Plant Certification and Registration Institute

⁵ Responsible for seed quality control laboratory

Abstract Triticale (*Triticosecale Wittmack*), is one of the strategic cereals in Iran and plays a crucial role in industries and livestock production. The current study was carried out with the aim of using image analysis to identify the specific traits of triticale and to register the best varieties in national DUS test. The experiment was conducted during 2023-2024 growing season at the experimental station of Razavi Seed & Plant Knowledge-based Institute, Mashhad, Iran. The field experiment was carried out based on a randomized complete block design with three replications. Five introduced cultivars of triticale were considered as the experimental treatments. For precise evaluation of candidate cultivars image analysis was conducted using standard indexes introduced by UPOV. When the straw pith in cross section was examined, cultivars B1 and B2 were significantly superior in compared to A1, A2 and A3. For instance, the value of this traits in B1 cultivar was observed to be twice more than A1. In terms of stem density of hairs on neck, the lowest value equal to 5 (DUS criterion) was detected in A3 cultivar, which was significantly lower than others. Furthermore, after checking ear distribution of awns, no significant difference was observed between the treatments.

Keywords: DUS, image analysis, Triticale

Materials and methods The experiment was conducted during 2023-2024 growing season at the experimental station, Razavi Seed & Plant Knowledge-based Institute, Mashhad, Iran. The field experiment was carried out based on a randomized complete block design with three replicates. Five cultivars of triticale including the candidate cultivar were considered as the experimental treatments. According to the local practice, the field was prepared by applying plow, disk, and leveler and then plots (2 m long × 1 m width) were designed. Between plots and blocks 2 m space were kept as buffer zone, respectively. According to the irrigation method, seeds were sown (250 per m²) at 2.5 cm depth with 25 cm distance between rows on 4th of October 2023. In the farm, no herbicide or fungicide were applied and weeds were controlled by hand-removal methods. During the growing season, plant length index was measured in the pre-physiological stage. Moreover, straw pith in cross section and ear distribution of awns were recorded in the physiological progress stage. Besides, stem density index on the neck was determined in the flowering stage. Finally, seed harvesting operation was implemented on 6th of July 2024.

To record the indexes of the plant indicators in cultivars, the micro-scale imaging method was done using image spectra processing program (stereo microscope, OPTIKA) and Mosaic 2.1 software. The analysis of variance and LSD test ($P \leq 0.05$) were performed using SAS 9.4 software.

Introduction Triticale (*Triticosecale Wittmack*) is one of the strategic cereals in Iran and plays a crucial role in industries and livestock production, and can considerably boost the national economy (Ghodsi et al., 2016). The requirement for this improvement is to achieve superior cultivars to be compatible with ecological situations and environmental conditions. The advancement of the national triticale development program is performed regarding the introduction and commercial registration of cultivars that are compatible with the climatic and environmental conditions, while having a higher yield and better fodder quality. Such adaptation is basically possible through increasing the resistance of the introduced variety against environmental stresses (Saed-Moucheshi et al., 2021). Achieving the crucial strategies are through the identification and introduction of compatible samples that have a higher potential in terms of quality and quantity compared to existing or control varieties. Obtaining superior cultivars is achieved through the implementation of controlled experiments with the aim of commercial registration of considerable cultivars, which is completed under the supervision and support of “Seed and Plant Certification and Registration Institute” in Iran. In this regard, the basis of tests is regarding VCU (*Value of Cultivation and Use*) and DUS (*Distinctness, Uniformity and Stability*) Testing that can play a special role in distinguishing the best samples. The DUS test is based on 3 mentioned algorithms (differentiation, uniformity, stability) implemented simultaneously in the research related to the registration of cultivars (Gilliland et al., 2020). About the registration of triticale variety, traits such as fluffiness of the spike, scattering of ribs, or transverse cutting of the stem are among the important criteria that are studied in connection with the DUS test (Raghu et al., 2023). In other words, it is necessary to perform these tests to identify and record such indicators that have a significant advantage over the controlled samples. The application of image analysis may recreate a special function, as a new and practical procedure, in identifying superior indicators; because this technique, with a much higher and more accurate microscale than the common identification instruments, can help to record distinctive traits between treatments (Tavakkol Afshari et al., 2024). According to the mentioned cases, the current study was carried out with the aim of using image analysis to identify the specific traits of triticale and to register the best varieties in the DUS test.



Seed 2024



Al-Qasim Green University



Razi University



Iranian Seed Scientific Association



Iranian Seed Scientific Association



Iranian Seed Scientific Association

The 2nd International Seed Science and Technology Conference of Iran

“Seed 2024”

(Medicinal Plant, Crop, Horticulture, Pasture & Forest)



CIVILICA



ISC

seed2024.razi.ac.ir

Results and Discussion Analysis of the variance of the experimental treatments in the triticale plant under the influence of DUS tests is presented in Table 1. From the results, indicators such as plant height, straw pith in cross section, ear distribution of awns, and stem density index on the neck have been studied. The results showed that there was no significant difference between the tested cultivars in terms of plant height; however, among the treatment, A1 had the highest height and B1 with the lowest recorded values. When the straw pith in cross section was examined, cultivars B1 and B2 were significantly superior in compared to A1, A2 and A3. For instance, the value of this traits in B1 cultivar was observed to be twice more than A1. In terms of stem density of hairs on neck, the lowest value equal to 5 (DUS criterion) was obtain in A3 cultivar, which was significantly lower than others. Furthermore, by checking ear distribution of awns, no significant difference was observed between the treatments. However, when the DUS test was implemented, the code number 3 was recorded indicating the high density in the stems of all cultivars. Such results show that micro-scale imaging technology can be very effective and useful in advancing the implementation of Davis tests with very high accuracy.

Table 1: Analysis of variance regarding experimental trait in triticale (*Triticum secale*) during DUS approach.

DUS test samples	Plant lengt	Straw pith in cross section	Stem density of hairs on neck*	Ear distribution of awns**
A1	95.00	0.491	7.00	3.00
A2	89.00	0.518	7.00	3.00
A3	92.00	0.539	5.00	3.00
B1	88.00	0.835	7.00	3.00
B2	90.00	0.887	7.00	3.00
LSD	16.93	0.1044	0.00	0.00

* Stem density of hairs on neck in triticale base on coding standard izatin in DUS approach (ranking from 1-9)

** Ear distribution of awns in triticale base on coding standard izatin in DUS approach (ranking from 1-9)

References Ghodsi, M., Zarea Faizabadi, A., Nazeri, M., Khodarahmi, M., Tajalli, H. and Azizi, Z., 2016. PAJ, New Iranian triticale suitable for cultivation in low-input lands of moderate region of Iran. Research Achievements for Field and Horticulture Crops, 5(2), pp.97-108.

Gilliland, T.J., Annicchiarico, P., Julier, B. and Ghesquière, M., 2020. A proposal for enhanced EU herbage VCU and DUS testing procedures. Grass and Forage Science, 75(3), pp.227-241.

Raghu, N., Ramesh, B., Dheeraj, G. and Lavanya, G.R., 2023. Morphological evaluation of chickpea (*Cicer arietinum* L.) genotypes based on DUS characteristics and character association among seed yield characters. International Journal of Plant & Soil Science, 35(20), pp.167-182.

Saed-Moucheshi, A., Sohrabi, F., Fasihfar, E., Baniasadi, F., Riasat, M. and Mozafari, A.A., 2021. Superoxide dismutase (SOD) as a selection criterion for triticale grain yield under drought stress: a comprehensive study on genomics and expression profiling, bioinformatics, heritability, and phenotypic variability. BMC plant biology, 21, pp.1-19.

Tavakkol Afshari, M., Tavakkol Afshari, R., Seyyedi, S.M. 2024. The effect of sowing date and deficit irrigation on quinoa seed (*Chenopodium quinoa* Willd.): understanding the morphology of embryo-cotyledons and germination characteristics based on image analysis, Arid Land Research and Management, DOI: 10.1080/15324982.2024.2368665.



Figure 1: Straw pith in cross section

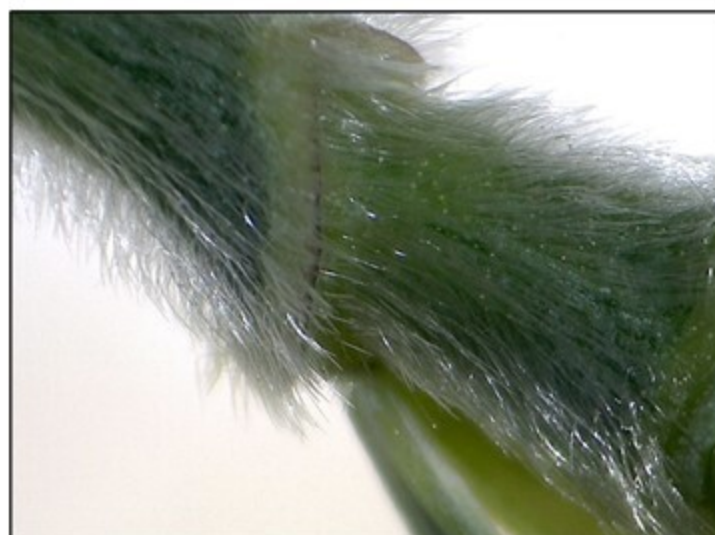


Figure 2: Stem density of hairs on neck