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Determination of Seed Quality Tests of Wheat Varieties under the Response of Different Sowing Dates and Nitrogen Fertilization

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Abstract: A two years field study was conducted to determine seed quality tests of wheat varieties under the response of different sowing dates and nitrogen fertilization at New Developmental Farm of Khyber Pakhtunkhawa Agricultural University, Peshawer, Pakistan under agro-climatic condition of Peshawar valley during 2008-09 and 2009-10. The experiment was laid out according to randomized complete block design having split plot arrangements with four repeats. Four planting dates (24th October, 13th November, 3rd December and 23rd December) with 20 days intervals allocated to main plots whole 4 levels of nitrogen (0, 100, 130 and 160 kg N/ha) along with two varieties (Pirsabak 2005 and Khyber-87) were allotted to sub plots. Wheat crop responded differently to sowing dates and nitrogen fertilization for various characters. Highest standard germination, field emergence, accelerated aging germination test and seedling dry weight were recorded under 24th October sowing but lowest values were obtained under delay seeded condition. Similarly these seed quality attributes of Khyber-87 significantly affected by nitrogen application. Early (Oct. 24th) seeding date in combination with 130 kg N/ha accelerated seed quality attributes of Khyber-87 whereas late seeded condition declined these parameters even using maximum dose of nitrogen.

Key words: Wheat, sowing dates, nitrogen levels, seed quality tests

INTRODUCTION

Wheat (*Triticum aestivum* L.) grain is the reservoir of nutrients and products of biosynthesis which have been accumulated by the plant during its lifetime. During vegetative growth the continuous flow of water and nutrients through the roots and stems, together with the carbon taken up from the atmosphere, provides the raw products for the synthesis of proteins and carbohydrates. The chemical composition of mature wheat grain is dominated by high starch content, typically about 72% of the total dry weight and protein content between 6-16%. Starch is present only in the endosperm, but protein is distributed through all parts of the grain. Therefore for growing healthy crop, there is a need to use optimum sowing date as well as to provide balance nutrition to the plants. The greater nitrogen supply increase shoot biomass by 29%, grain yield by 16%, protein by 5% but decrease harvest index by 10% (Ehdaie *et al*., 2001). The performance of seed is determined by its viability, purity, germination percentage, electrical conductivity, field emergence and seedling dry weight. Germination percentage increased with nitrogen fertilization (Warraich *et al*., 2002). The increase in germination percentage with nitrogen application may be due to increased grain volume, weight and kernel size of wheat as pointed by Ottman *et al*. (2000) and maximum germination rate is one of the best measure for good quality determination. In addition to nitrogen application, sowing dates also contributes in the seed quality. Delay in sowing affecting the quality due to short duration for growth and grain filling. The author Abdullah *et al*. (2007) also emphasized that delay sowing significantly affected the quality characteristics of wheat. Khan *et al*. (2010) works on seed quality determination tests and examined that higher electrical conductivity results poor germination and Vieira *et al*. (1999) also determined that higher EC is an indication of the low vigor due to an increase in membrane permeability of the lower vigor seeds. Sufficient supply of nitrogen at optimum planting times resulted vigorous seed. In view of this consideration, the objective of this work was to study the determination of seed quality tests of two wheat varieties under the response of different sowing dates and nitrogen fertilization.

MATERIALS AND METHODS

Two years field experiment entitled "determination of seed quality tests of wheat varieties under the response of different sowing dates and nitrogen fertilization" were made at New Developmental Farm of Khyber Pakhtunkhawa Agricultural University Peshawar, Pakistan during the two successive seasons 2008/09 and 2009/10. Soil has clay loam texture, low in organic matter (0.87%), extractable phosphorus (6.57 mg/kg),

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exchangeable potassium (121 mg/kg) and alkaline in nature (pH 8.2) (Amanullah *et al*., 2009). A trial layout consisted of Randomized Complete Block Design having split plot arrangement with four replications. The experiment comprised two factors. Factor A contained four sowing dates (Oct. 24th, Nov. 13th, Dec. 3rd and Dec. 23rd) with 20 days intervals randomly kept in main plots and factor B included two varieties (Pirsabaq-2005 and Khyber- 87) and four nitrogen levels (0, 100, 130 and 160 kg ha^{-1}) were randomized in the sub plots each measuring 5 x 0.3 m. The amount of nitrogen was split into two portions. Half dose of nitrogen in the form of urea (46%N) and whole dose of phosphorus and potash in the form of triple super phosphate (46%P_2O_5) and murate of potash (60%K_2O) respectively were applied immediately at sowing time. The remaining half dose of nitrogen was given at second irrigation. Seed quality vigor was determined by different types of tests in laboratory as well as in field by adopting various procedures. Standard germination test was conducted in the laboratory. 100 seeds from each treatment replicated four times were placed in germination trays between two sheets of standard germination paper and these trays were kept in germinator at 25°C for and days. The germination trays were monitored daily and water was applied when needed. The % age of germination was calculated from the total number of seedlings. The seedlings obtained after standard germination test were further used for seedling dry weight test. The plumule and radicals were detached from cotyledon and were placed in paper bags, dried in oven at 60°C for 24 h and noted the seedling dry weight (gm) of seeds collected from each treatment. Field emergence test were made at the New Developmental Farm of Khyber Pakhtunkhawa Agricultural University Peshawar, Pakistan on silty clay loam soil in April 2009 and April 2010. Four replications of 100 seeds of each variety were planted by hand each year in 4 meter rows at a depth of 5 cm. The plots were furrow irrigated to maintain uniform soil moisture conditions. Daily counts were made as soon as the seedlings begin to emerged and continued until emergence was completed. Electrical conductivity test was used to quantify the leakage of electrolytes from the seed coat with respect to age, storage life and other factors i.e. temperature, humidity, soil and water stress etc. A sample of 50 seeds was taken from each treatment, placed in a 250 ml flask and 200 ml of distilled water was added. The flask was stirred to remove air bubbles and floating seed, covered with aluminum foil and was kept at 35°C for 24 h. After soaking, the seeds were swirled and the conductivity of the soaked water was measured with a dip type cell (Cell Constant of 1.0) conductivity meter. Conductivity was expressed on a weight bases in Micro-siemens cm^{-2} g^{-1} of seed ($\mu scm^{-2}g^{-1}$) as describe by Anonymous (2002a). Accelerated aging germination test is a hard vigor determining test for seed lots. This test was conducted by using the "Jar" accelerated aging system proposed and described by Baskin (1977). Wire mesh stands were used to support the seed, which was placed in a muslin cloth bag and tied with a rubber band. The distance of the seed was 8 cm above the surface of the water in the bottom of the jar. Maximum water was used to maintain nearly 100 % relative humidity. Two lots of 50 seeds of each variety from each treatment replicated four times were placed in the jars. The jars utilized for accelerated aging treatments were kept for 72 h at 420°C. After aging, the jars were removed from the incubator and a standard germination test as described above were used for all seed samples and seedlings were counted at 7th day (Anonymous, 2002b). All the data collected during two years were subjected to statistical analyses using MSTAT-C. Least Significant Difference Test at 5% probability was used to test the significant differences among mean values of each treatment (Steel and Torrie, 1997).

RESULTS AND DISCUSSION

Individual effect of sowing Dates (D), Nitrogen (N) and their interaction with varieties for Standard Germination (SG), Field Emergence (FE), Electrical Conductivity (EC) and Accelerated Aging (AA) germination test were statistically significant while Seedling Dry Weight (SDW) test was found significant under D, N and D x V as listed in Table 1, 2, 3, 4 and 5. Highest SG, FE, AA and SDW were recorded under 24th October sowing but lowest values were obtained under delay seeded condition (Table 1, 2, 4 and 5) Similarly delay sowing increases the EC of wheat seed but early sowing reduces the concern value as shown in Table 3. Smaller endosperm and lower grain weight (Ahmad, 1994), higher grain crude protein and lower grain size (Patil *et al*., 2000) are the main causes of delayed sowing which resulting in low vigorous seed and seed vigor is a good estimator of the SG tests of seed lots. Lowest FE of the seed lot could be justified by the less ideal condition of the seedbed in the field which makes it possible to reduce the emergence as compared to favorable condition of the laboratory for maximum value of germination (Makkawi *et al*., 1999). Our present results matched well with the findings of Khan *et al*. (2007) who also concluded significant relationship among sowing dates and field emergence. Possible reason for lower germination after Accelerated Aging (AA) test might be that late seeded crop produced low vigorous seeds which reduce germination after AA test. Similarly physiological and biochemical changes in the seeds subjected to AA had a gradual decline in vigor leading to slower and less uniform germination (Alsandon *et al*., 1995). More leak of solute or release of electrolytes resulted maximum EC value under delayed sowing might be due to low vigor. Researchers Khan *et al*. (2010) and Samarah and Al-Kofahi (2008) have examined that EC provided the best estimate of seed

Table 1: Mean table for standard germination (%) test of wheat varieties as affected by sowing dates and nitrogen fertilization

Treatments	Pirsabaq 2005	Khyber-87	Mean
24th October	93.406bc	97.875a	95.6405a
13th November	92.188bc	94.688b	93.4375ab
3rd December	90.531c	91.688bc	91.1095bc
23rd December	85.875d	92bc	88.938c
LSD Value = 3.044		LSD Value = 4.331	
0 kg N ha^{-1}	89.906e	92.438abc	91.172a
100 kg N ha^{-1}	92.219bcd	94.094ab	93.1565a
130 kg N ha^{-1}	89.25de	95.406a	92.328a
160 kg N ha^{-1}	90.625cde	94.313ab	92.469a
LSD Value = 3.044		LSD Value = 4.318	
2008-09	94.625	90.875	92.7501
2009-10	93.5	90.125	91.8126
Mean	94.0625	90.5	92.28135
Interaction	P-value	Interaction	P-value
Y x D	>1	Y x D x V	>1
Y x N	>1	Y x V x N	>1
D x N	0.0007	D x V x N	0
Y x D x N	>1	Y x D x V x N	>1

Table 2: Mean table for field emergence (%) test of wheat varieties as affected by sowing dates and nitrogen fertilization

Treatments	Pirsabaq 2005	Khyber-87	Mean
24th October	80.656ab	82.344a	81.500a
13th November	80.594ab	80.125ab	80.359b
3rd December	78.438bc	82.125a	80.281b
23rd December	75.813c	76.406c	79.609b
LSD Value = 3.644		LSD value = 3.404	
0 kg N ha^{-1}	78.813bc	82.781a	80.797
100 kg N ha^{-1}	76.281c	83.188a	79.734
130 kg N ha^{-1}	79.781abc	81.281ab	80.531
160 kg N ha^{-1}	80.625ab	80.750ab	80.688
LSD Value = 3.644			
2008-09	78.844b	82.125a	80.484
2009-10	78.906b	81.875a	80.391
Mean	78.879	82	80.45
LSD Value = 5.154			
Interaction	P-value	Interaction	P-value
Y x D	>1	Y x D x V	>1
Y x N	>1	Y x V x N	>1
D x N	0	D x V x N	0
Y x D x N	>1	Y x D x V x N	>1

Table 3: Mean table for electrical conductivity (µs cm^{-1} g^{-1}) test of wheat varieties as affected by sowing dates and nitrogen fertilization

Treatments	Pirsabaq 2005	Khyber-87	Mean
24th October	22.739c	22.927c	22.83c
13th November	23.244c	23.187c	23.22b
3rd December	25.586b	21.928d	23.76a
23rd December	21.232e	26.319a	23.78a
LSD Value = 12.37		LSD Value = 10.96	
0 kg N ha^{-1}	23.532cd	23.484cd	23.51ab
100 kg N ha^{-1}	24.697a	23.013de	23.86a
130 kg N ha^{-1}	21.824f	24.245b	23.04c
160 kg N ha^{-1}	22.748e	23.619c	23.18bc
LSD Value = 12.37		LSD Value = 17.49	
2008-09	23.117	23.538	23.327
2009-10	23.283	23.643	23.463
Mean	23.2	23.59	23.98
Interaction	P-value	Interaction	P-value
Y x D	>1	Y x D x V	>1
Y x N	>1	Y x V x N	>1
D x N	0	D x V x N	0
Y x D x N	>1	Y x D x V x N	>1

Table 4: Mean table for accelerated aging germination (%) test of wheat varieties as affected by sowing dates and nitrogen fertilization

Treatments	Pirsabaq 2005	Khyber-87	Mean
24th October	88.344a	87.063a	87.703a
13th November	82.844a	68.469b	75.6565b
3rd December	74.75b	72.938b	73.844b
23rd December	32.438d	54.156c	43.297c
LSD Value = 7.938		LSD Value = 6.557	
0 kg N ha^{-1}	70.906b	56.625de	63.766d
100 kg N ha^{-1}	66.063bc	79.313b	72.6875ab
130 kg N ha^{-1}	83.781a	70.875b	77.328a
160 kg N ha^{-1}	70.531e	62.906cd	66.719ab
LSD Value = 7.938		LSD Value = 11.23	
2008-09	69.969	70.75	70.3595
2009-10	69.219	70.563	69.8908
Mean	69.594	70.6565	70.12515
Interaction	P-value	Interaction	P-value
Y x D	>1	Y x D x V	>1
Y x N	>1	Y x V x N	>1
D x N	0	D x V x N	0
Y x D x N	>1	Y x D x V x N	>1

vigor and reported that higher EC of seed lot results poor germination due to low vigor.

The increase in germination percentage (Table 1) with nitrogen application may be due to increased grain volume, weight and kernel size of wheat as pointed by Ottman *et al.* (2000). The same result was concluded by Warraich *et al.* (2002). Overall results of electrical conductivity test in Table 3 shows that EC of the seed leachates increased with increase in nitrogen levels up to 100 kg ha^{-1} and after that further increase in nitrogen dose decreases the values of EC. Filho *et al.* (1994) stated that nitrogen application in form of urea produce best results in term of EC of soybean seeds. Maximum and minimum germination values after conduction of AA test (Table 4) were obtained under 130 kg N/ha and 0 kg N/ha respectively. The increase in germination rate after fertilizer application could be due to more dry matter accumulation in the endosperm of seed which improved vigor of the seed lot. Highest and lowest SDW values as indicated in Table 5 were obtained from the seeds fertilized with 160 kg N/ha and 0 kg N/ha respectively. Nitrogen application improves the seed vigor which ultimately resulted in more standard germination and finally more SDW obtained. The Khyber 87 recorded for maximum standard germination in laboratory, field emergence and seedling dry weight when their seeds obtained from early sown plots, followed by lowest values in Pirsabaq 2005 seed lots when received from late sown condition. Germination after accelerated aging

Table 5: Mean table for seedling dry weight (mg) test of wheat varieties as affected by sowing dates and nitrogen fertilization

Treatments	Pirsabaq 2005	Khyber-87	Mean
24th October	0.039a	0.046a	0.042a
13th November	0.038a	0.045a	0.041a
3rd December	0.042a	0.041a	0.041a
23rd December	0.032a	0.032a	0.032a
LSD Value = 0.031		LSD Value = 0.470	
0 kg N ha^{-1}	0.034	0.041	0.038a
100 kg N ha^{-1}	0.037	0.04	0.038a
130 kg N ha^{-1}	0.037	0.04	0.039a
160 kg N ha^{-1}	0.043	0.042	0.043a
LSD Value = 0.044			
2008-09	0.036	0.04	0.0382
2009-10	0.039	0.041	0.04
Mean	0.0375	0.0405	0.0391
Interaction	P-value	Interaction	P-value
Y x D	>1	Y x D x V	>1
Y x N	>1	Y x V x N	>1
D x N	0	D x V x N	0.0004
Y x D x N	>1	Y x D x V x N	>1

test was found maximum under the interaction of pirsabaq 2005 with early sowing date while the same variety give minimum germination after AA test under late sowing condition. Similarly pirsabaq 2005 recorded best in term of low value of EC as compared to Khyber-87. Khyber 87 responded more to 130 and 100 kg nitrogen application for achieving highest germination in laboratory and field emergence but 0 kg N/ha decline the values of the concern seed quality characteristics. 130 kg ha^{-1} nitrogen application enhance the germination of Pirsabaq 2005 after accelerated aging test. The same nitrogen level was observed best for low value of EC in the seed lot of Pirsabaq 2005 as compared to other levels of nitrogen. Genetic variability of varieties make differences in the values of seed quality parameters.

Conclusion: To summarize the overall results of this study it is generally concluded that early (Oct. 24th) seeding date in combination with 130 kg N/ha accelerated seed quality attributes of Khyber-87 whereas late seeded condition declined these parameters even using maximum dose of nitrogen.

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