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Morphological and Biochemical Variability among Six Popular Varieties of Wheat

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Abstract

Six popular varieties of wheat namely; K-68, K 8207, K 9107, K 9162, PBW 443 and HUW 234 revealed that all these varieties possess variability in terms of morphology and biochemical parameters. Wheat variety K-68 is tall with medium tillering whereas, K 9107 is semi dwarf with synchronous tillering in habit. The potentiality of grain yield also differed amongst the varieties, showing a maximum of 54q ha^{-1} in K 9107 against 27q ha^{-1} in the variety K 8027. The test weight and crop duration also varied widely. Biochemical analysis of the wheat varieties revealed that among the six wheat varieties, the maximum soluble protein (41.86 mg g^{-1} of fresh leaf) was observed in the variety K 9107, which was followed by K 8027 (39.23 mg g^{-1} of fresh leaf) whereas, HUW 234 exhibited lowest value of 32.54 mg g^{-1} of fresh leaves. Similarly, total phenol content was also found maximum in the variety K 9107 (3.92 mg g^{-1} of fresh leaf) against a maximum of 3.24 mg g^{-1} of fresh leaf in HUW 234. SDS-PAGE profiling of soluble protein revealed that the number of bands present in each variety ranged from 06 to 12, indicating variability among the six wheat varieties in this respect. Similarly, crude protein, total nitrogen and fat per cent in wheat flour also showed variation among the varieties.

1. Introduction

Wheat (*Triticum aestivum* L.) is widely cultivated crop eaten in various forms by more than one thousand million human beings in the world. The world wide importance of wheat can be realized from the fact that the centre of FAO symbol has a bearded wheat spike with a Latin motto "fiat pains" meaning "let there be bread". In India, the contribution of wheat to total food grain production has been ranging between 35-37% in last five years. A strong team of dedicated research workers have developed over 150 high yielding wheat varieties during last three decades in the country. By adopting these varieties, the farmers have placed the country in a comfortable position. Today, wheat alone contributes around 13 million tones of our total buffer stock. Recently, the Government of India has liberalized the policy for export of wheat but our traders could not make full utilization of this policy. The reason being that, we do not have sufficient information relating to the quality status of our wheat and to enter the global grain trade and to stay back, quality of wheat is the sole criterion. Anonymous (1973-1976).The major problem is that our procurement system is quantity oriented and is not concerned with the quality. The entire produce is heaped, with the result that the quality aspect is completely lost; standards fixed by the importing countries could not be fulfilled unless we design our objective to make our produce with high profit earning. There is wide variability in the quality of our wheat. Keeping in view the above facts, the present investigations were under taken to find out the morphological and biochemical variability among popular varieties of wheat.

2. Materials and Methods

The present investigation was undertaken at Agriculture Research Farm and Department of Plant Pathology, C.S.A. University of Agriculture & Technology, Kanpur, to evaluate the variability among six popular varieties of wheat namely, K-68, K 8207, K 9107, K 9162, PBW 443 and HUM 234, commonly used by the farmers around the vicinity of Kanpur. The experiment was laid out in RBD with four replications. The seeds were sown on 5th December, 2008 and recommended agronomical practices were followed. Observations on morphology of plants were recorded at 71 DAS. The leaf samples were collected for estimation of total soluble protein and total phenol content in wheat leaves. The yield and duration of crop was calculated after harvest of crop. Soluble protein were extracted from the leaf samples and estimated following

Lowary et al. (1951). The absorbance at 660 nm against a reagent blank was measured using UV-VIS Spectro-photometer and the standard curve using different concentrations of bovine serum albumin was prepared. Concentration of soluble protein in the test sample was extrapolated from the standard curve and expressed as mg soluble protein g^{-1} of fresh leaf sample. The accumulation of total phenols in wheat leaves was estimated following Bray and Thorpe (1954) procedure. The absorbance at 650 nm against a reagent blank was measured using UV-VIS spectro-photometer and the standard curve using different concentrations of catechol was prepared. Concentration of phenols in the test sample was extrapolated using the standard curve and expressed as mg phenol g^{-1} of sample material. The nitrogen content of wheat leaves was estimated by Micro-Kjeldahl method. Crude protein was determined by multiplying total N content in defatted wheat by the factor 6.25.

Profiling of soluble proteins was carried out in leaves of different varieties of wheat through polyacrylamide gel electrophoresis was carried out the study of variability among popular wheat varieties. Polyacrylamide gel electrophoresis was done to get soluble protein pattern. Soluble proteins were electrophorised on 12% SDS-PAGE as described by Laemmli, (1970). The electrophoresis was carried out for 6 hours in Tris-glycine buffer at 30 mA current in stacking gel and 40 mA in separating gel. The fat content in flour of different wheat grains was determined by Soxhlet extraction procedure, using petroleum ether of B.P. 60-80^{o}C.

3. Results and Discussion

3.1. Growth and yield

Morphological characters are mainly on plant height and habit of tillering. Morphological descriptors are useful in assessing the genetic purity and identity of the varieties in Grow out Tests. In the present study, the morphological variation among six popular varieties of wheat in respect of plant height showed significant variation (Table 1). Wheat variety K 68 is tall with medium tillering whereas, K 9107 was found to be semi-dwarf with synchronous tillering habit. The variety K8027 represented both medium tillering and plant heights. Thus, out of six varieties, two are dwarf (HUW 234 & PBW 343), two are semi dwarf (K 8027 & K 9162), one is tall (K 68) and one is medium (K 9107) in plant height. Variation in growth habit of wheat varieties is influenced by sowing date, fertilization and irrigation (Behra, 1994; Singh et al., 1984). Tomar and Mathur (1966) also reported that the plant height of wheat crop was found to be more in early sown crop (first week of November) than late sown (second week of December).

Table 1: Morphological characteristics of different varieties of wheat

No.	Variety	Morphological characters
1	K 68	Tall in plant height, medium tillering
2	K 8027	Semi dwarf, synchronous medium tillering
3	K 9107	Medium plant height, tillering medium
4	K 9162	Semi-dwarf, synchronous medium tillering
5	PBW 343	Dwarf in plant height, high tillering
6	HUW 234	Dwarf in plant height, high tillering

Data presented in Table 2 showed that K9107, K8027, PBW343, were late maturity varieties than others. However, HUW 234 and K9162 were found to be short duration varieties.

Table 2: Variation in duration of crop, yield and test weight of different wheat cultivars

No.	Variety	Duration (days)	Yield (q ha^{-1})	Test wt (g)
1	K 68	125	50	38
2	K 8027	125	27	36
3	K 9107	130	54	40
4	K 9162	120	38	38
5	PBW 343	130	53	36
6	HUW 234	120	31	38
SEm ±		0.70	0.14	0.14
CD (p=0.05)		2.11	0.46	0.46

Statistical analysis of the data revealed that the varieties K9107, K8027, PBW343 were statistically at par and showed non significant difference in crop duration (130 days). On the other hand, K 9162 and HUW 234 varieties had 120 days crop duration.

The data on yield of different varieties presented in Table 2 showed that the maximum grain yield (54 q ha^{-1}) was recorded in the variety K 9107, which was also statistically at par with PBW 343 (53 q ha^{-1}). The minimum with 27 q ha^{-1} yield was recorded in the variety K 8027. Wheat varieties K 68, PBW 343 and K9107 were significantly greater than HUW 234, K 9162 and K 8027 in respect of yield. The yield data of different varieties indicated that yield potentiality of each variety is different. The potentiality of yield of wheat varies from variety to variety has been reported by several workers. Singh et al. (1984) noted that VL 421 variety is superior to UP 368 and Sonalika.

Test weight determines the size of grain. The data presented in able 2 revealed that test weight of variety K 9107 was highest at 40 g. However, lowest test weight was found in the varieties K 8027 and PBW 343 (36). On the basis of test weight, it was found that the varieties were significantly different to each

other except K 8027 and PBW 343. Ammawath and Mobesa (1993) analysed the physio-chemical properties of six wheat cultivars grown in northern Thailand and reported that there was variation in test weight and ash content of wheat grain. Gangwar and Sharma (1998) found that highest grain yield was recorded in WH 542 while Sangam produced lowest grain yield. Shivani et al. (2001) reported that two varieties HUW234 and K9006 did not differ significantly in respect of grain yield.

3.2. Biochemical properties

The result of total nitrogen in wheat leaf presented in Table 3 indicated that total nitrogen content was maximum (2.68%)

Table 3: Biochemical variation in mature leaves of different wheat cultivars

No.	Variety	N (%)	TP (%)	TSP (mg g^{-1})	TPl (mg g^{-1})
1	K 68	2.25	14.06	35.54	3.61
2	K 8027	2.59	16.19	39.23	3.70
3	K 9107	2.50	15.63	41.86	3.92
4	K 9162	2.68	16.75	32.79	3.42
5	PBW 343	2.56	16.00	36.39	3.38
6	HUW 234	2.64	16.50	32.54	3.24
SEm ±		0.15	0.11	2.87	0.10
CD (p=0.05)		0.51	0.36	8.66	0.31

TP: Total protein; TSP: Total soluble protein; TPl: Total phenol

in leaves of K 9162, while minimum nitrogen content was 2.25 % in variety K 68. Varieties K 9162, HUW 234 and K 8027 showed non-significant difference in respect of nitrogen content in wheat leaves with the value of 2.68%, 2.64% and 2.59% respectively. On the other hand, the variety PBW 343 and K 9107 showing 2.56% and 2.5 % nitrogen were also statistically at par. Similarly, crude protein content was found maximum with 16.75 percent in the variety K 9162, followed by variety HUW 234, K 8027 and PBW 343 with 16.5%, 16.19% and 16.00% respectively. Mishra (2008) reported that variable content of crude proteins was also found in different wheat varieties.

The content of soluble protein in wheat leaf is one of the determining factors of variability (Mishra et al. 2010). In the present study, the data presented in the Table 3 showed that the soluble protein content in wheat varieties varied significantly. The maximum soluble protein with 41.86 mg g^{-1} of fresh leaf was observed in the variety K 9107, followed by K 8027 (39.23 mg g^{-1} of fresh leaf). Among the six wheat varieties, HUW 234 exhibited 32.54 mg g^{-1} of fresh leaves of soluble protein content which was the lowest value. The observation on total protein content in different varieties of wheat revealed that variety HUW 234 and K 9162 were statistically at par. The result is supported by the findings of Lee et al., (1986). They found that genotypic differences are responsible for variable protein content among the varieties of wheat.

Phenol is another important parameters for determination of variability (Mishra et al., 2010). Data presented in the Table 2 showed that the total phenol content varied from variety to variety. The maximum total phenol content (3.92 mg g^{-1} of fresh leaf) was found in the variety K 9107 where as, HUW 234 showed minimum amount of phenol content (3.24 mg g^{-1} of fresh leaf). The observation on total phenol content in different varieties of wheat revealed that varieties K 68 with K 8027 and PBW 343 with K 9162 were statistically at par. It may be concluded from the table that the value for total phenol in variety K 9107 was significantly higher than rest of all these varieties. Biochemical responses of wheat plants due to supplemental UV-B radiation and enhanced O_3 were reduced biomass, yield, photosynthetic rate, chlorophyll, carotenoid and ascorbic acid content and increased total phenol content and peroxidase activity (Ambasht and Agrawal, 2004).

SDS-PAGE is a powerful tool for reliable varietals discrimination and identification based on protein profiling of leaf protein of wheat varieties. Wheat varieties can be distinguished from each other based on presence and absence of number of bands. The data showed that the number of bands present in each variety ranged from 06 to 12.

The highest number of bands was found in variety PBW 343 and minimum number of bands was shown in variety K 68. A new protein band of high molecular weight at position number 1 was found in variety K 9107 which was not found in rest of the varieties .Similarly, another new band at position number 4 was found in K 9162 and HUW 234. At position number 6 & 7, some bands are missing in variety, K 8027. An additional new band between position 4 & 5 was found in variety PBW 343. Therefore, it can be concluded on the basis of different banding pattern of wheat varieties presented in the plate 1, that all the varieties are different from each other. Mishra et al. (2010) reported that resistance response to Alternaria blight by different varieties of wheat revealed that all the varieties give variable response on disease severity. They also found that banding pattern of soluble protein showed that quantitative and qualitative differences exist between the varieties.

The result presented in the Table 4 revealed that the maximum 2.20 percent nitrogen was recorded in wheat flour of variety K 9107. The percent of nitrogen in varieties K 68, HUW 234 and K 9162 with values of 1.79, 1.76 and 1.78 respectively showed significant differences with each other. Minimum nitrogen percent was found in variety K 8027 with 1.75 percent. Similarly, crude protein content in variety K 9107 was more than rest of the varieties indicating, K 9107 was significantly different from rest of the varieties. A comparative study on quality parameters

Table 4: Variation in total nitrogen, protein and fat content in different varieties of wheat grain

No.	Variety	N (%)	Crude protein (%)	Fat (%)
1	K 68	1.79	11.18	1.54
2	K 8027	1.75	10.94	1.98
3	K 9107	2.20	13.75	2.20
4	K 9162	1.78	11.13	1.58
5	PBW 343	1.80	11.25	1.25
6	HUW 234	1.76	11.00	1.28
SEm ±		0.13	0.16	0.25
CD (p=0.05)		0.41	0.56	0.62

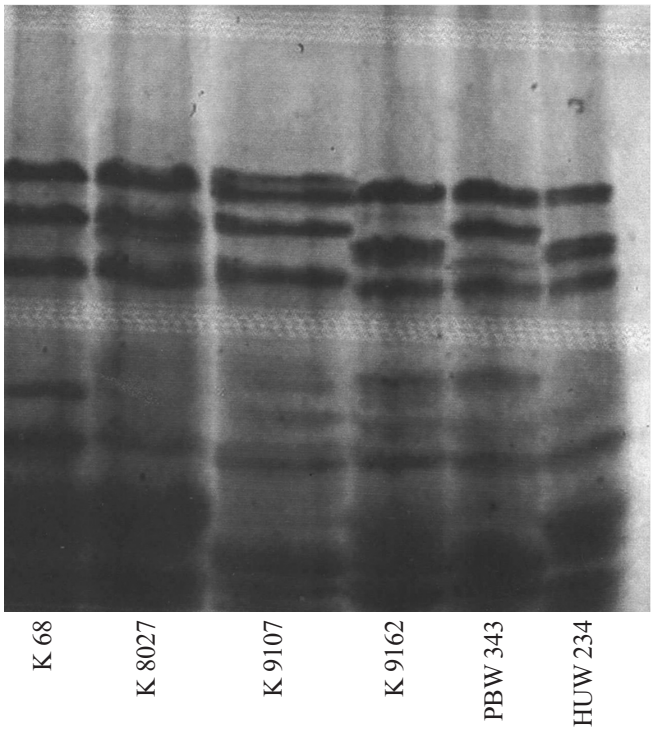

Plate 1: Protein profiling of soluble leaf protein of different varieties of wheat

among 12 winter and 4 spring cultivars of Triticale with wheat showed that wheat were superior to cultivars of triticale in all quality aspect except protein content (Boros and Rokowska, 1991). Degidio et al. (1992) analyzed the relationship among the ash content, protein content and sedimentation value of wheat flour and observed positive relationship among them with reduction in paleographic characters. Manus and Khan (1992) reported that the protein content of wheat flour is 16 percent in durum wheat. Rajaram et al. (1992) observed that the durum wheat is having high protein content of about 17 percent with high quality protein and gluten content. Analysis on protein content, sedimentation value and ash content of six wheat cultivars showed that there was significant variability among them (Ammawath and Mobesa, 1993).

The percent of fat in wheat grain showed that the variety K 9107 registered 2.20% fat in wheat grain, which was highest among all varieties followed by variety K 8027 which had 1.98% fat. The minimum fat percent (1.25%) was recorded in variety PBW 343. Other varieties like K 9162, HUW 234 with value of 1.58 % and 1.28 % respectively showed significant difference in fat content. Bhatt and Vivian (1980) reported that the content of lipids in the wheat chapattis was 1.3 percent. They also observed that by addition of soy flour with wheat flour, the contents of crude protein increased whereas the amounts of lipids in chapattis decreased.

4. Conclusion

It may be concluded from the present investigation that the morphological and biochemical variability existed among all the six popular varieties of wheat. The variable content of crude protein, nitrogen per cent and fat in wheat flour and total phenol and soluble protein content in wheat leaves are also the indication of variability. Profiling of soluble protein was also confirmed the existence of biochemical variability within the varieties.

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