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Effect of Seed Size on some Agro-morphological Traits of three bread Wheat (*Triticum aestivum* L.) Cultivars

Virender Singh[1], Davinder Sharma[2] and Vipin Panwar[3]

[1,2,3]ICAR-IIWBR, Karnal
E-mail: [1]virenderssheoran@gmail.com, [2]dskaushis.81@gmail.com

Abstract—*Seed size is an important physical indicator of seed quality that effects vegetative growth and is frequently related to yield, market grade factors and harvest efficiency. In a field experiment the effect of five seed sizes (1, 1-2, 2-2.5, 2.5-2.8, 2.8-3.5 mm) on grain yield and yield components was determined with three bread wheat (DBW88, HD2967, WH1105) cultivars. Significant differences were observed for Plant height (PH), days to heading (DTH), number of plant tillers (PT), grain number (GN) and grain yield (GY). Days to maturity (DTM), harvest index (HI) and thousand kernel weight (TKW) showed no significant difference for different seed sizes.*

Keywords*: Seed size, wheat, yield traits*

1. INTRODUCTION

Bread wheat is major source of food grain and high adaptation of this plant as well as its diverse consumptions in the human nutrition lead to present as the most important cereal in the world [1]. In modern agriculture, seed is a vehicle to deliver almost all agriculture-based technological innovations to farmers so that they can exploit the genetic potential of new varieties. The availability, access and use of seed of adaptable modern varieties is, therefore, determinant to the efficiency and productivity of other packages (irrigation, fertilizers, pesticides) in increasing crop production to enhance food security and alleviating rural poverty in developing countries [2]. Planting of high quality seed is one of the most significant factors in improving crop establishment and yield. Healthy and bold seed provides more nutrients for early growth, leading to good establishment and vigorous growth, which is important for competitive ability against weeds and pests. A wide array of different effects of seed size has been reported for seed germination, emergence and related agronomical aspects in many crop species [3-5]. However, these results varied widely between species. In wheat, seed size not only influence emergence and establishment but also affected yield components and ultimately grain yield [6]. Larger seeds of spring wheat produced higher yields than smaller seeds under

late-sown conditions [7], but not under optimum management conditions [8]. Similarly, Khah et al. [9] found that low-vigor spring wheat seed produced lower yields only when it planted in low plant populations or when planting was later than normal. Hasstrup et al. [10] reported that wheat and barley yield would be decreased by increase of seed germination duration due to low seed vigor. Chastain et al. [11,12] observed no consistent yield or grain quality advantages obtained from large winter wheat and barley seed. However, Mian and Nafziger [13] noticed seed size has little effect on emergence of soft red winter wheat. In the present study, effects of different seed size on some agro-morphological traits of wheat cultivars were investigated.

2. MATERIALS AND METHODS

Seeds of three wheat cultivars namely DBW88 (KAUZ,MEX//ALTAR-84/AWNED-ONAS/3/MILAN/ KAUZ,MEX/4/HUITES), HD2967 (ALD/CUC//URES /HD216OM/HD2278) and WH1105 (MILAN/S87230 //BABAX) were used in this study. Seed samples were sorted with screening machine (Sortimat K5; Pfeuffer GmbH, Kitzingen, Germany) and placed into five groups of seed diameter size 1, 1-2, 2-2.5, 2.5-2.8 and 2.8-3.5 mm. The control comprising seeds of all sizes was also taken. The field trial was conducted during crop season 2014 at the experimental field of IIWBR, Karnal, India (alt. 748ft, 29042'N, 77002'E). Sowing was done in replication with IIWBR Dibbler fabricated by Sharma et al. [14] to ensure precision in planting following randomized complete block design. IIWBR Dibbler was used to place three seeds at one locus without any overlap at fixed depth of 6.5 cm within a small experimental unit of four rows of 0.5 m length with 20 cm space between the rows and 10 cm between the plants within the rows. Two of the three plants were uprooted 15 days after sowing to finally retain one plant at each locus and 48 plants in each plot. Inorganic fertilizers were applied at recommended rates (150 : 60 : 40 kg N : P2O5 :K 2O/ha). Full P and K along with one-third N were applied at the time of planting and the two-third N was applied at growth stage GS 31 [15]. The fungicide propiconazole (Tilt 25 EC at 0.1%) was sprayed at GS 47 and GS 71 to prevent yellow rust. Irrigation was provided to the crop at five growth stages (at crown root initiation Zadok, GS 21; tiller completion Zadok, GS 29; late jointing Zadok, GS 36; flowering Zadok, GS 61; and milk stage Zadok, GS 75) to maintain optimum soil moisture. Weeds were removed manually.

Evaluation of the material was done for different agro-morphological traits viz. plant height (PH, measured at growth stage, GS87), Days to heading (DTH, counted as the number of days from sowing until 50 per cent of the ear emerges in each line), Days to maturity (DTM, estimated as the date when 50% of the plants in each plot had their rachis turned yellow), productive plant tiller number (PT, plants at the centre of each plot were selected to count the number of tillers at growth stage, GS85). The postharvest measurements included grain number per spike (GN) which was estimated counting total grains from eight representative plants of

each plot and divided by PT. Grain yield (GY) obtained after weighing the threshed grains. Thousand kernel weight (TKW) was taken after weighing thousand grains counted by seed counter. To avoid border effects, 20 plants at the centre of each plot were chosen for collecting all the data. Biomass (BM) was evaluated after the crop harvest and Harvest index (HI) was calculated as follows:

HI = Yield/total biomass*100

3. RESULTS AND DISCUSSION

Analysis of variance was performed with the PROC GLM procedure in SAS (SAS Institute Inc., v. 9.1.) by treating genotypes and replication as random factors.

4. RESULTS AND DISCUSSION

The main effects of seed size on different agro-morphological traits (PH, DTH, DTM, PT, GY, GN, HI, TKW) of three bread wheat cultivars are shown in Table 1. Figure 1 shows that for different seed sizes, proportion of 2.8mm seeds was maximum in DBW88 and HD2967 whereas in WH1105 maximum proportion was of seed size 2.5mm. In this study, no difference in seed germination among different seed sizes was observed and was consistent with that of Mian and Nafziger [13] who reported that seed size had no effect on germination characteristics in wheat. Small-seeded genotypes are probably physiologically most efficient, especially at warmer sites and higher latitudes [16]. Results of variance analysis indicated significant interaction between cultivar and seed sizes for PH, DTH, PT, GN and GY whereas no significant difference was observed for DTM, HI and TKW (Table 2). For plant height smallest seed size (1 mm) seed size differed significantly from bigger seed sizes. In DBW88 2.5 mm sized seeds had maximum height (87.4 cm) and height of 80.4 cm was observed for smallest seed size (1mm). In HD2967 minimum height (78.8 cm) was recorded for smallest seed size (1 mm) whereas 2.8mm seed size showed maximum height (88.7 cm). Whereas in WH1105 minimum height (82.3 cm) was recorded for seed size 2 mm and maximum height (87.2 cm) was observed in 2.8 mm seed size. Data indicated that main stem development was influenced by seed size. Plants grown from large seed were taller. Rukavina et al. [17] reported similar results. Considering days to heading, seed size of 3.5 mm showed earlier heading as compared to 1 mm seed size in all the three cultivars. Whereas, no difference among different seed sizes was observed for days to maturity. Number of plant tillers (PT) per plot was significantly different for seed sizes in the cultivars studied. In DBW 88 minimum PT per plot were observed in 1 mm seeds (47.5) and maximum (67.5) in 2.8mm seeds. In WH 1105 maximum PT were observed in 3.5 mm seeds (63) and minimum in 2.5 mm sized seeds. Although, in HD 2967 the trend was reverse maximum PT was in 2 mm seeds and minimum in 2.8 mm seed size. Significant difference was also observed for grain yield (GY) and grain number in all the three cultivars. GY in DBW 88 was obtained minimum for 1 mm sized seeds (68.8 g) and maximum for 2.8 mm seeds (104.5 g) per plot and similar trend was observed

for genotype HD 2967. In WH 1105, GY was recorded minimum of 74.5 g in 2.8 mm seed size and maximum of 106.4 g for 3.5 mm sized seeds. In other crops, Tuba Bicer 18] in chickpea and lentil found that plants from large seeds yielded 6% more than medium seeds and 10% more than mixed seeds. Spilde [19] compared yield among small, medium and large seed sizes in wheat and barley and reported maximum yield in large sized seeds and minimum in small seeds. Rukavina et al. [17] in barley, informed that grain yield significantly declined by 9.8% from large seed compared to very small seed. Grain number (GN) per plot was minimum is smallest seed size (1 mm) and maximum in 2 mm sized seeds in DBW 88 and similarly trend was seen in HD 2967. Whereas GN in WH 1105 was observed minimum in 2.5 mm seeds and maximum in 3.5 mm seeds. These results showed that GN increased by increasing seed size and confirms the earlier study [20]. In this study no significant differences among the cultivars was observed for HI. Significant difference in TKW for seed sizes was observed in two cultivars namely HD 29 67 and WH 1105. TKW ranged from 26.2 g (1 mm) to 35 g (3.5 mm) and 27 g (1 mm) to 32.7 g (3.5 mm) in HD 2967 and WH 1105, respectively.

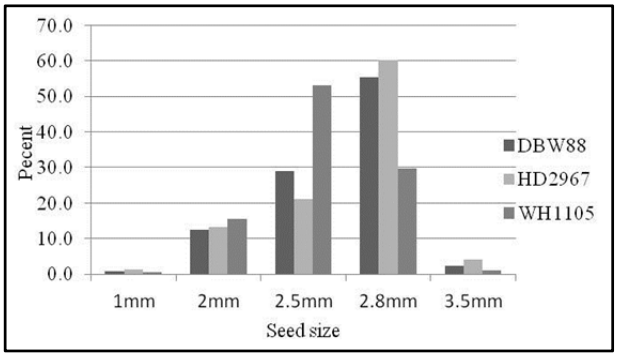

Figure 1; Percent proportion of different seed sizes in three wheat cultivars

Similar result was recorded by Rukavina et al. [17]. The results of the present study concluded that there is significant interaction between wheat cultivars for and different seed sizes for various agro-morphological traits.

Table 1: Mean values of different agro-morphological traits of three individual wheat cultivars for five different seed sizes

Cultivar	SIZE (mm)	PH (cm)	DTH	DTM	PT	GY (g)	GN	HI	TKW (g)
DBW88	1	80.4±2.3	76.5±1.5	109.5±1.3	47.5±4.1	68.8±7.5	2267±257	42.9±3.5	31.7±2.0
	2	86.5±2.3	73.0±1.5	109.0±1.3	66.0±4.1	104.0±7.5	3305±257	38.7±3.5	33.6±2.0
	2.5	87.4±2.3	71.0±1.5	108.0±1.3	60.5±4.1	99.3±7.5	3126±257	43.8±3.5	32.7±2.0

	2.8	86.0±2.3	71.5±1.5	107.5±1.3	67.5±4.1	104.5±7.5	3119±257	39.4±3.5	32.1±2.0
	3.5	86.0±2.3	69.5±1.5	107.5±1.3	52.5±4.1	81.7±7.5	2449±257	39.0±3.5	32.3±2.0
	Control	82.9±2.3	73.5±1.5	107.0±1.3	64.0±4.1	99.5±7.5	3085±257	37.1±3.5	29.2±2.0
HD2967	1	78.8±1.1	78.5±1.3	107.5±0.9	79.0±5.6	94.4±8.5	2301±288	32.1±3.3	26.2±0.9
	2	84.5±1.1	77.5±1.3	107.0±0.9	81.5±5.6	97.8±8.5	3476±288	37.0±3.3	28.2±0.9
	2.5	86.9±1.1	74.0±1.3	107.0±0.9	69.0±5.6	83.7±8.5	2539±288	34.6±3.3	33.1±0.9
	2.8	88.7±1.1	76.0±1.3	106.5±0.9	66.0±5.6	99.9±8.5	2971±288	38.2±3.3	34.0±0.9
	3.5	86.2±1.1	73.0±1.3	104.0±0.9	74.0±5.6	104.1±8.5	3023±288	39.1±3.3	35.0±0.9
	Control	84.5±1.1	76.5±1.3	105.0±0.9	76.0±5.6	98.8±8.5	3162±288	41.0±3.3	30.5±0.9
WH1105	1	83.7±1.5	73.0±1.4	106.0±0.9	59.0±2.9	92.6±4.6	3184±244	33.1±2.7	27.0±1.9
	2	82.3±1.5	72.0±1.4	105.0±0.9	62.0±2.9	75.6±4.6	2749±244	34.5±2.7	28.6±1.9
	2.5	84.2±1.5	69.0±1.4	105.0±0.9	55.0±2.9	89.9±4.6	2700±244	32.7±2.7	31.4±1.9
	2.8	87.2±1.5	68.5±1.4	105.5±0.9	61.5±2.9	74.5±4.6	2359±244	30.5±2.7	31.8±1.9
	3.5	86.4±1.5	67.0±1.4	105.0±0.9	63.0±2.9	106.4±4.6	3633±244	43.2±2.7	32.7±1.9
	Control	84.8±1.5	71.0±1.4	104.5±0.9	62.5±2.9	94.0±4.6	3138±244	39.0±2.7	30.1±1.9

PH- Plant height DTH-days to heading DTM-days to maturity PT- number of plant tillers GY- grain yield GN- grain numbers HI- harvest index TKW- thousand kernel weight
± denotes standard error

Table 2: Results of analysis of variance for the examined agro-morphological traits (Probability values)

Effect	PH (cm)	DTH	DTM	PT	GY (g)	GN	HI	TKW (g)
Interaction (Cultivar*Seed size)	0.0496	0.0006	0.0727	0.0024	0.0273	0.0377	0.2334	0.0434

PH- Plant height DTH-days to heading DTM-days to maturity PT- number of plant tillers GY- grain yield GN- grain numbers HI- harvest index TKW- thousand kernel weight

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