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PRODUCTIVITY AND PROFITABILITY OF WHEAT PAK-13 AT DIFFERENT SEEDING DENSITIES UNDER RAINFED CONDITIONS

Syed Haider Abbas*, Ayesha Tahir**, Muhammad Asim***, Muhammad Sohail* and Riaz-ud-Din*

ABSTRACT:- Wheat is the major food crop of Pakistan. Newly developed wheat cultivar Pak-13 was evaluated by an assortment of seeding densities planted at NARC, Islamabad during the rabi season of 2014-15. The experiment was done under Randomized Complete Block Design and was replicated four times having six different seeding densities (SD1: 50, SD2: 75, SD3: 100, SD4: 125, SD5: 150 and SD6: 175 kg/ha) The analysis revealed that the highest chlorophyll contents (49.5), number of tillers/m^2 (240), biological yield (7125 kg/ha), and grain yield (2660 kg/ha) were achieved at seeding density 100 kg/ha and was significantly different among various levels of seeding density. Again, the profitability analysis show the maximum gross margin (Rs. 98920/ha) and BCR (3.44) at 100 kg/ha seeding density level.

Key Words: Profitability, Benefit Cost Ratio; Wheat; Pak-13; Rainfed ecology.

INTRODUCTION

Wheat is the major staple food crop of Pakistan. Its contribution to the value added in agriculture and GDP was 10.0 percent and 2.1 percent respectively. Area under wheat crop was 9180 thousand hectares with the production of 25.478 million tonnes during 2014-15 (GOP, 2014-15).Wheat yield in Pakistan is low due to many factors and among those factors poor understanding of seeding densities is also observed. Agriculture farming in rainfed areas of Pakistan is becoming difficult due to escalation of prices of fertilizers, fuel costs, seed costs, labor costs, herbicides costs, transportation costs and harvesting costs. Farmers in rainfed ecology of Pakistan are either using high seed rates or low seed rates for wheat crop which is ultimately hampering the main targets of yields.

Optimum seed density is very much important for achieving higher yield and minimizing the cost of production since most input costs are increasing day by day. Higher seeding densities cause interplant competition for space, moisture, nutrients while low seed density leads to poor weed competition and poor crop stand which ultimately reduce yield of wheat crop (Jenniferet al., 2005). Breeding in wheat crop is highly appreciable as due to continuous efforts of wheat researchers yield has inclined many times since the inception of Pakistan and it stands at 2547 kg/ha as compared to 100 kg/ha. However, every wheat cultivar is not ideally suited for both irrigated and rain fed ecology. Efforts must be

** Planning and Development Division, Pakistan Agricultural Research Council, Islamabad.*
*** Wheat Program, CSI, National Agricultural Research Centre, Islamabad.*
**** Plant Sciences Division, Pakistan Agricultural Research Council, Islamabad.*
Corresponding author: ashfju1@gmail.com

centralized to get such type of wheat which can perform well in both conditions. Optimum seeding density is an important management tool for improving the yield of wheat (Sikander et al.,2009). It is of scrupulous importance in wheat production because it is under the farmer's control in most cropping systems (Slafer and Satorre, 1999). Optimum plant densities vary significantly between areas, climatic conditions, soil, sowing time, and varieties (Darwinkel et al. 1977). Seeding density is one of the prime determinants which show the ability of the crop to detain resources.

There has been attention in defining the relationships between plant density and crop yield quantitatively in order to establish optimum populations and maximum reasonable yields under various situations. As a result, the effect of density on wheat plant size and crop productivity has received significant importance (Harper, 1977). Proper seeding density is an important tool for better health and vigor of plants. Wheat yield can be enhanced by breeding techniques if coupled with modern agronomic practices like fine seedbed preparation, timely sowing, pure seed, optimum seeding density, balanced nutrients use, right herbicide use and mechanized harvesting and threshing techniques. Various investigations on the importance of optimization of seeding density also stressed on appropriate level of using seed density in particular ecology (Arain et al., 2002; Mahboob et al., 2005;Masood et al., 2005). New wheat varieties are much productive and have better grain quality as compared to previous, but complete production technological package including seeding density, planting time, balanced use of fertilizers, timely weed control and harvesting are of prime importance which must be tested in area specific (Caglar et al., 2011).

Hence keeping in view the importance of optimum seeding density for newly released wheat cultivar Pak-13, the study was designed for analyzing the most agro-economic feasible level for recommendation to ultimate user in rain fed areas of Pakistan.

MATERIALS AND METHOD

A field experiment was executed at Research Farm Area of National Agricultural Research Centre, Islamabad during 2014-15. The Randomized Complete Block Design was used for six seeding densities (SD1: 50,SD2: 75,SD3: 100, SD4 :125,SD5: 150 and SD6: 175 kg/ha) to evaluate new wheat cultivar Pk-13 under rainfed conditions and was replicated four times. The plot size was 6 x 5 m^2. It was sown in the 2nd week of November to evaluate its performance in relation to seeding densities. Before sowing of the crop soil properties were also determined with standard sampling techniques. During the course of analysis various traits like plant height (cm),spike length (cm), chlorophyll contents (with the help of chlorophyll meter), leaf area, number of tillers/m^2,biological yield (kg/ha), and grain yield (kg/ha) were taken. The following procedures were used for taking the data on individual parameter of the crop. Number of tillers m^{-2} was taken by counting in one meter length area of the three central rows in each subplot and their average was then calculated. Four middle rows were harvested, it was air

dried and weighed to record biological yield which was converted on per hectare basis. Four rows were harvested for grain yield and threshed. After threshing the grains were cleaned, dried and weighed to record the grain yield and finally analyzed in Statistical Software at 5% probability level as described by Steel and Torrie (1997).

Profitability Analysis

The collected data were analyzed by using Statix Software. The profitability analysis of wheat was calculated by using the data of seed densities and hence benefit cost ratio was calculated from the same field trails data. The researchers calculated the gross margin by subtracting total variable cost from the total revenue,

GM = TR-TVC ..... (1)

Where,

GM is gross margin (Rs./ha), TR is total revenue (Rs./ha), and TVC is total variable cost of production (Rs./ha)

Again, the benefit-cost ratio (BCR) was computed by using the following formula:

B/C = TR/TVC ..... (2)

RESULTS AND DISCUSSION

Agro climatic Conditions (2014-15)

The climatic conditions for the reported season under study are summarized in Figure 1. The maximum rainfall was noted in the month of March (306.53 mm). It was also observed that there was almost no rainfall in the months of November and December,2014, at the times

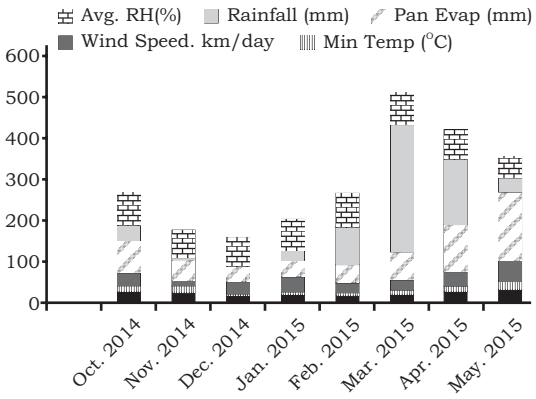

Figure 1. Climatic Conditions during cropped period (2014-15)

moisture was needed for better plant establishment. The air temperature during the season was normal. Maximum air temperature of October 2014, November, December, January 2015, February, March and April, 2015 were 28.0, 24.6, 20.0, 23.0, 19.4 and 22.0 and 27.5°C respectively (Figure 1). The maximum average temperature was recorded in the month of April (27.5°C). The minimum average temperature was observed in the month of December (2.77°C). Average relative humidity from October, 2014 to April, 2015 varied from 68% to 78% and maximum was noted in the month of February, 2015 i.e 78%. Wind speed during the reported season varied from 20.2 to 37.5 km/day and maximum was in the month of January i.e 37.5. Evapotranspiration was maximum in the month of April, 2015 (115.5mm), whereas lowest noted was in the month of December, 2014 (38.6mm).

Soil Status of Experimental Field

Before sowing of the crop soil sampling was done randomly to assess various soil related traits. (Table 1).

Table1. Soil status of NARC, wheat land area (2014-15).

S. No	Parameter	Value
1	Soil Texture	Loam
2	pH	7.79
3	O.M	0.5 %
4	Phosphorus	6.4 mg/kg
5	Potassium	100 mg/kg
6	Nitrogen	0.025 %
7	TOC	0.29 %

Effect of Seeding Densities

It shows that varying seeding densities had no significant effect on plant height. The highest was noted in SD3 Level having 90.5 cm, whereas the lowest was recorded in SD2 (88.6 cm). These findings are in contrary with the results of Baloch et al, 2010 who reported that there was significant difference for plant height in seeding densities. It was shown that varying seeding densities had no significant effect on spike length. The highest was noted in SD2 level having 12.1 cm, whereas the lowest was recorded in SD6 (11.1 cm). These results are in conferment with the findings of Baloch et al., 2010, who reported that there was no significant difference in various seeding densities for spike length. Different seeding densities had significant effect on chlorophyll contents. The highest was noted in SD3 level having 49.5, whereas the lowest was recorded in SD6 (47.1). Varying seeding densities had no significant effect on leaf area. The highest was noted in SD5 level having 28 cm^2, whereas the lowest was recorded in SD1 (27 cm^2). However, varying seeding densities had significant effect on the number of tillers/m^2. The highest was noted in SD3 level having 240tillers/m^2, whereas, the lowest was recorded in SD2 (153 tillers/m^2). These results are in conferment with the work of Hussainet al., (2010) who narrated that various seeding densities were significantly different for number of tillers/m^2 in wheat crop (Table 2).

Varying seeding densities had significant effect on biological yield (kg/ha). The highest was noted in Sd3 level having 7125 kg/ha, whereas the lowest was recorded in SD1 (5375 kg/ha). These results are in conferment with the work of Shah et al.,

Table 2. Effect of various seeding densities in Pak-13 wheat variety

Seeding Densities (kg/ha)	Plant Height (cm)	Spike Length (cm)	No of Tillers /m^2	Leaf Area (cm^2)	Chloro-phyll Contents	Biological Yield (kg/ha)	Grain Yield (kg/ha)
SD1 (50)	90.5	11.9	170^{bc}	27.05	48.2^{ab}	5375.0^{b}	2030.0^{b}
SD2 (75)	88.7	12.1	153^{c}	27.42	47.7^{ab}	6250.0^{ab}	2342.5^{ab}
SD3 (100)	90.5	11.7	240^{a}	27.80	50^{a}	7125.0^{a}	2660.0^{a}
SD4 (125)	89.5	11.6	224^{ab}	27.85	47^{b}	6625.0^{ab}	2552.5^{a}
SD5 (150)	89.9	11.3	209^{abc}	28.02	47.3^{ab}	6375.0^{ab}	2420.0^{ab}
SD6 (175)	90.3	11.2	203^{abc}	27.38	47.1^{ab}	6875.0^{a}	2557.5^{a}
LSD (5%)	n.s	n.s	60.949	n.s	2.5414	1323.8	515.31

Source: Authors calculation

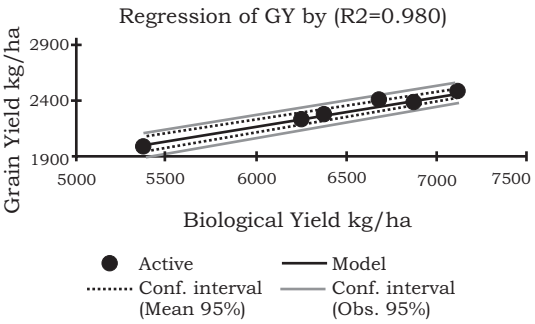

Figure 2. Regression Analysis between Bio and Grain yield for Pak-13 Wheat Cultivar

(2011) who narrated that various seeding densities were significantly different biological yield (kg/ha) in wheat crop. Again, varying seeding densities were significantly different for grain yield. The highest was noted in SD3(100 kg/ha)level having 2660 kg/ha, whereas the lowest was recorded in SD1 (2030 kg/ha). These results are in conferment with the work of Shah et al., (2011) and Hussain et al., (2010) who narrated that various seeding densities were significantly different for grain yield (kg/ha) in wheat crop.

A strong relationship (0.98) was found during regression analysis between biological yield and grain yield (kg/ha) (Figure 2).

Productivity and Profitability of Pak-13 Wheat Cultivation

The grain yield computed for various seeding densities is given in Table 3. The plots seeded with 100 kg/ ha produced maximum (Rs. 98920) net returns, while those in 50 kg/ ha seed had minimum (Rs. 69880) net returns. The data also revealed that BCR (benefit cost ratio) was higher when seed rate was applied @ 100 kg/ ha gave (3.44) BCR, while plots @ 50 kg/ ha seed had , the minimum BCR (2.4). These findings are in contrast with the results of Shah et al., 2011 who reported that 120 kg/ha seeding density was optimum in wheat crop (Table 3)

CONCLUSION

Rainfed crop production is a high risk task in Pakistan, when coupled with changing climatic conditions, increasing prices of seeds and fertilizers. In the current study it was found that the optimum seeding density of Pak-13 wheat cultivar for getting higher returns under rainfed conditions. Among various seeding densities, 100 kg/ha provided the best option for getting higher grain

Table 3. Profitability of Pak-13 wheat cultivar under various seeding densities

Seeding Densities (kg/ha)	Grain Yield (kg/ha)	Value of Produce (PKR)	Cost of Seed (PKR)	Total Variable Cost (PKR)	Gross Margin (PKR)	BCR on Variable Cost
SD1 (50)	2030	97440	3600	27560	69880	3.54
SD2 (75)	2342.5	112440	2400	26360	86080	4.27
SD3 (100)	2660	127680	4800	28760	98920	3.44
SD4 (125)	2552.5	122520	6000	29960	92560	3.09
SD5 (150)	2420	116160	7200	31160	85000	2.73
SD6 (175)	2557.5	122760	8400	32360	90400	2.79

yield (kg/ha). Moreover, profitability analysis revealed that maximum profit was obtained at 100 kg/ha seeding density level having maximum gross margin of Rs. 98920/ha. Hence, from agronomic and economic point of view, 100 kg/ha seeding density was the optimum seed rate for cultivating Pak-13 wheat cultivar for obtaining maximum level of yield and gross margin. However, the concern authority may take immediate steps to discriminate this variety to the end user (farmer) of Pakistan.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

S. No	Name	Contribution to the paper
1	Mr. Syed Haider Ali Shah	Conceived the idea, methodology, Did SPSS analysis, Technical in put at every step, Data Collection, Data entry in SPSS and analysis
2.	Ms. Ayesha Tahir	Methodology, Technical in put at every step, overall Management of the article, Data entry in SPSS and analysis, result and discussion
3.	Mr. Muhammad Asim	Conclusion, references
4.	Mr. Muhammad Sohail	Introduction
5.	Dr. Ruaz-ud-Din	Wrote Abstract

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