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Research Article

Demonstration and evaluation of the effect of different seeding techniques on the yield of wheat in standing cotton.

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Abstract

Wheat (*Triticum aestivum* L.) is the staple food of Pakistan. Planting of wheat after 20th of November reduces its productivity. Wheat planting is delayed due to late picking of cotton. A field experiment was conducted during winter seasons 2011-12 and 2012-13. The effect of different seeding techniques on the yield of wheat as relay crop sown in standing cotton was evaluated at Adaptive Research Farm Rahim Yar Khan. Four different seeding methods (broadcasting of dry seed just before irrigation, broadcasting of soaked seed (4hr) just before irrigation, broadcasting of dry seed immediately after irrigation and broadcasting of soaked seed (4hr) after irrigation) of wheat sown in standing cotton were evaluated in a three replicated RCBD method. Results revealed that all the yield and yield parameters were significantly affected by seeding methods applied of wheat in standing cotton. The average of two years result revealed that significant maximum plant germination i.e 107.27 m^{-2}, tillers i.e 338.85 m^{-2}, height 110.46 cm, 1000 grain weight i.e 42.50 (g) and grain yield of 4640 kg ha^{-1} was obtained when dry wheat seed was broadcasted immediately after irrigation. Different seeding methods were economical for all wheat varieties when sown in standing cotton.

Keywords: Wheat (*Triticum aestivum* L.) , different seeding methods, RCBD method, grain weight.

Introduction

Wheat (*Triticum aestivum* L.) cereal crop responds differently to various agro management practices especially planting methods. Punjab is a major contributor of wheat in Pakistan where most of the area under wheat comes after cotton crop. Wheat sowing under these two cropping systems especially cotton-wheat cropping system is delayed which causes significant yield reduction. Usually low yields are obtained by conventional methods of wheat planting. Wheat cultivation on raised beds has been investigated for its suitability in rice-wheat and other cropping systems (cotton-wheat) of the Indo-Gangetic Plains Hobbs and Gupta, (2003).Sowing of wheat is delayed due to late harvest of the preceding kharif crops like cotton, rice, maize, sunflower etc and additional time required for intensive cultivation for conventional seedbed preparation. According to an estimate,

wheat yields under farmer's condition decline on an average @ 30-40 kg ha^{-1} day^{-1} when planted after 20 November (Anonymous, 1999). Planting method has a significant effect on water, nitrogen and phosphorus economy, energy savings and soil compaction Trodson *et al.* (1989). Absorption of photo synthetically active radiations has also been found to be influenced by planting methods Lal *et al.* (1991).

One of the ways to avoid such delay in planting of wheat is to shift from conventional seedbed preparation to surface seeding of wheat on no tilled soil in the standing kharif crop. Such relay cropping of wheat at zero tillage has been reported to produce wheat yields comparable to those obtained from wheat raised on conventionally prepared seedbed Verma *et al.* 1989; Akram, (1992). In that case two potential problems associated with the relaying surface seeding of wheat at zero tillage that are poor plant stand establishment and greater weed infestation. Pre-sowing soaking of the wheat seed can alleviate the former problem. This occurs because wheat planting is often delayed by 20-44 days due to late picking of cotton, and subsequent tillage and field preparation operations for wheat planting. Sowing wheat after 20th November in this region reduces the productivity at the rate of 1.0-1.5 % per day Nasrullah *et al.* (2010), reducing average yield after cotton by > 0.5 t ha^{-1}. Stapper and Fisher (1990) have also pointed out that wheat planted after cotton harvest in general faces an unfavorable temperature regime and smaller window for growth and development, leading to lower yields.

Carver, (2005) investigated the impact of different crop establishment methods, i.e. conventional drilling, precision drilling and broadcasting in winter wheat. Broadcasting method produced the most effective spatial arrangements. The raised beds for wheat production facilitates double-cropping and offer significant advantages in controlling soil moisture, both irrigation and drainage, and are amendable to narrow row spacing Mascagni *et al.* (2010). Wheat could be grown successfully on beds, with the advantage of reduced irrigation water requirement, seed rate, lodging and low population of *Phalaris minor* Quanqi *et al.* (2008).

The maximum grain yield in broadcast method of dry seed immediately after irrigation can be described to higher number of spikelets $spike^{-1}$, number of grains $spike^{-1}$ and 1000-grain weight, which was favored because of better growing condition in broadcast method. Similar findings were also reported by carver (2005), Ahuja *et al*. (1996), Raj *et al*. (1992) and Serma and Medhy (1995). Dawelbeit and and Babiker (1997) have reported maximum yield for seed drilling and ridging after broadcasting than broadcasting alone. The results indicate that proper seed rate and sowing method increased plant vitality and yield. It encourages nutrient availability, proper sun light penetration for photosynthesis Chang *et al.* (1991).

Materials and Methods

The experiment was conducted at Adaptive Research Farm Rahim Yar Khan during two consecutive years 2011-12 and 2012-13. The objective of this study was to check the effect of different seeding techniques on the yield of wheat as relay crop sown in standing cotton. The experiment was laid out in Randomized Complete Block design (RCBD) with three replications. Wheat variety Faisalabad-2008 was used to check four different seeding techniques as mention in table 1. In 1st technique dry seed of wheat just before irrigation was broadcasted in standing cotton as relay crop. While in case of 2nd technique soaked seed (4hr) of wheat just before irrigation was broadcasted in standing cotton. While in 3rd and 4th case dry and soaked seed (4hr) of wheat was broadcasted immediately after irrigation in standing cotton as relay crop scheme. Seed rate of wheat was used 173kg ha^{-1} (70kg $Acre^{-1}$) in standing cotton. High seed rate was used for attaining maximum germination so that plant population may not be suppressed by the standing cotton plants. The dry and soaked seed (4hr) was broadcasted in the 1st week of November in both experimental years. The previous crop was cotton in this field which was sown on 2nd fortnight of May. Cotton picking was done from the month of October to December. Field was irrigated and after four hours immediately wheat seed was broadcasted carefully. When dry seed used in the field it required some moisture to

germinate, while in case of soaked seed the seed have moisture to grow if the soil don't have enough moisture for seed germination. In case of soaking less seed rate used to fill the gaps. Cotton sticks were pulled out at the last week of December. Weedicides were used for the control of narrow and broad leaved weeds during mid January and february. During wheat season four irrigations were applied. Harvesting was done during 1st week of May.

Following growth and yield parameters were recorded.

1. Germination count/m^2
2. Tillers/m^2
3. Plant height (cm)
4. 1000 grain weight(g)
5. Yield kg/ha

Collected data were subjected to analysis of variance test to discriminate the treatments (LSD).

Table 1 Different seeding techniques of wheat in standing cotton as relay cropping system.

Treatments	Different seeding techniques
T_1	Broadcasting of dry seed before irrigation
T_2	Broadcasting of soaked seed (4hr) just before irrigation
T_3	Broadcasting of dry seed immediately after irrigation
T_4	Broadcasting of soaked seed (4hr) immediately after irrigation

Results and Discussion

All the treatments showed significant effect on the growth and yield parameters during two years of experiment. During 2011-12 as mentioned in table 2 plant germination was maximum (101.33 m^{-2}) when dry seed of wheat was broadcasted immediately after irrigation followed by soaked seed (4hr) of wheat broadcasted immediately after irrigation. i.e (95.33 m^{-2}), followed by dry seed broadcasted before irrigation in standing cotton i.e (87.33 m^{-2}). The minimum plant germination (81.33m^{-2}) was obtained when soaked seed (4hr) broadcasted just before irrigation. If germination is low it will automatically lowers the yield and tillering capacity of the wheat plant. An adequate moisture supply was continued for facilitating seed germination and seedling establishment (Zhang, 2007).

Important parameter which directly affected economic yield was fertile tillers m^{-2}. The maximum fertile tillers m^{-2} were observed (345.67) when dry seed of wheat was broadcasted immediately after irrigation in standing cotton followed by soaked seed (4hr) broadcasted before irrigation i.e (314.33) and (305.33) dry seed broadcasted before irrigation in standing cotton for the treatment T_1. The broadcasting seeding techniques of dry and soaked seed (4hr) before and after irrigation in standing cotton as relay crop were non significant for the height (cm) of wheat crop in all above four treatments. The height observed in T_1 seeding technique was 109.87 followed by 108.93 and 108.53 for the treatments T_3 and T_4. The height 107.60 was observed in T_2 which is less than all others treatments. The maximum 1000 grain weight was recorded as (42.33g) for the treatment T_3 followed by (40.33g) for the treatment when soaked wheat seed (4hr) broadcasted after irrigation. Then it was observed for the treatments T_1 as (36g) as when dry wheat seed was broadcasted just before irrigation. The lowest (33.33g) was observed for the treatment T_2 when soaked seed (4hr) broadcasted before irrigation. The data regarding grain yield ha^{-1} as mentioned in table 2 during 2011-12 envisaged that yield was affected significantly by different seeding techniques as applied in standing cotton zero tillage stage. The highest grain yield (4500 kg ha^{-1}) was obtained for treatment when dry seed of wheat was broadcasted immediately after irrigation in standing cotton followed by (4170kg ha^{-1}) for the treatment T_4 when soaked seed (4hr) of wheat broadcasted immediately after irrigation. A yield of (3650kg ha^{-1}) was observed for T_1 when dry seed broadcasted just before irrigation in standing cotton. The lowest yield (3280kg ha^{-1}) was observed for the T_2 when soaked seed (4hr) was broadcasted before irrigation. Khan and Salim (1986) reported that early planted wheat crop resulted in higher yields as compared with late planting crop.

During 2012-13 as mentioned in table 3 plant germination was maximum (113.22 m^{-2}) when dry

Table 2 Effect of seeding techniques on the yield of wheat in standing cotton during 2011-12

Treatments	Plant germination (m^{-2})	Fertile tillers (m^{-2})	Height (cm)	1000 grain wt. (g)	Yield (kg ha^{-1})
Seeding techniques					
T_1Broadcasting of dry seed before irrigation	87.33c	305.33bc	109.87	36c	3650c
T_2Broadcasting of soaked seed (4hr) just before irrigation	81.33d	248.33d	107.60	33d	3280d
T_3 Broadcasting of dry seed immediately after irrigation	101.33a	345.67a	108.93	42a	4500a
T_4 Broadcasting of soaked seed (4hr) immediately after irrigation	95.33b	314.33b	108.53	40b	4170b
LSD (0.05)	**3.246**	**22.71**	**N.S**	**1.706**	**387.089**

Table 3 Effect of seeding techniques on the yield of wheat in standing cotton during 2012-13

Treatments	Plant germination (m^{-2})	Fertile tillers (m^{-2})	Height (cm)	1000 grain wt. (g)	Yield (kg ha^{-1})
Seeding techniques					
T_1Broadcasting of dry seed before irrigation	106.22c	301.23cd	108	37c	4180c
T_2Broadcasting of soaked seed (4hr) just before irrigation	102.22d	289.02d	102	32d	3720d
T_3 Broadcasting of dry seed immediately after irrigation	113.22a	332.04a	112	43a	4780a
T_4 Broadcasting of soaked seed (4hr) immediately after irrigation	109.22b	317.23b	110	40b	4420b
LSD (0.05)	**3.046**	**14.71**	**N.S**	**2.706**	**232.068**

Table 4 Effect of seeding techniques on the yield of wheat in standing cotton average of two years (2011-12 & 2012-13)

Treatments	Plant population (m^{-2})	Fertile tillers (m^{-2})	Height (cm)	1000 grain wt. (g)	Yield (kg ha^{-1})
Seeding techniques					
T_1Broadcasting of dry seed before irrigation	96.77c	303.28bc	108.93	36.50c	3915c
T_2Broadcasting of soaked seed (4hr) just before irrigation	91.77d	268.67d	104.80	32.50d	3500d
T_3 Broadcasting of dry seed immediately after irrigation	107.27a	338.85a	110.46	42.50ab	4640a
T_4 Broadcasting of soaked seed (4hr) immediately after irrigation	102.27b	315.78b	109.26	40.00b	4295b
LSD (0.05)	**3.146**	**18.71**	**N.S**	**2.206**	**309.57**

seed of wheat was broadcasted immediately after irrigation followed by soaked seed (4hr) of wheat broadcasted immediately after irrigation. i.e (109.22 m^{-2}), followed by dry seed broadcasted before irrigation in standing cotton i.e (106.22 m^{-2}). The minimum plant germination (102.22m^{-2}) was obtained when soaked seed (4hr) broadcasted just before irrigation. If germination is low it will automatically lowers the yield and tillering capacity of the wheat plant. An adequate moisture supply was continued for facilitating seed germination and seedling establishment (Zhang, 2007).

Important parameter which directly affected economic yield was fertile tillers m^{-2}. The maximum fertile tillers m^{-2} were observed (331.04) when dry seed of wheat was broadcasted immediately after irrigation in standing

cotton followed by soaked seed (4hr) broadcasted immediately after irrigation i.e (316.23) and (301.23) when dry seed broadcasted before irrigation in standing cotton for the treatment T_1. The lowest tiller was observed as (289.02) when soaked seed (4hr) of wheat was broadcasted just before irrigation. The broadcasting seeding techniques of dry and soaked before and after irrigation in standing cotton as relay crop were non significant for the height (cm) of wheat crop in all above four treatments. The height observed in T_3 seeding technique was 112 followed by 110 and 108 for the treatments T_4 and T_1. The height 102 was observed in T_2 which is less than all others treatments. The maximum 1000 grain weight was recorded as (43g) for the treatment T_3 followed by (40g) for the treatment when soaked wheat seed (4hr) broadcasted after irrigation. Then it was observed for the treatments T_1 as (37g) as when dry wheat seed was broadcasted just before irrigation. The lowest (32g) was observed for the treatment T_2 when soaked seed (4hr) broadcasted just before irrigation. The data regarding grain yield ha^{-1} as mentioned in table 3 during 2012-13 envisaged that yield was affected significantly by different seeding techniques as applied in standing cotton zero tillage stage. The highest grain yield (4780 kg ha^{-1}) was obtained for treatment when dry seed of wheat was broadcasted immediately after irrigation in standing cotton followed by (4420kg ha^{-1}) for the treatment T_4 when soaked seed (4hr) of wheat broadcasted immediately after irrigation. A yield of (4180kg ha^{-1}) was observed for T_1 when dry seed broadcasted before irrigation in standing cotton. The lowest yield (3720kg ha^{-1}) was observed for the T_2 when soaked seed (4hr) was broadcasted just before irrigation. Similar findings were also reported by carver (2005), Ahuja *et al*. (1996), Raj *et al*. (1992) and Serma and Medhy (1995).

From the two years average (pooled) data 2011-13 in table 4, it was concluded that maximum grain yield (4640 kg ha^{-1}), plant germination (107.27 m^{-2}), fertile tillers m^{-2} (338.85 m^{-2}), height (110.46cm) and 1000 grain weight (42.50g) were observed when dry wheat seed was broadcasted immediately after irrigation in standing cotton as relay crop.

Conclusions

It was concluded that planting wheat as broadcast seed in dry condition immediately after irrigation produced maximum grain yield (kg ha^{-1}), plant germination (m^{-2}), fertile tillers (m^{-2}), height (cm) and 1000 grain weight (g) when sown in standing cotton as relay crop.

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