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Effect of crop establishment methods, irrigation regime, hydrogel and salicylic acid application on yield components and nutrient content of wheat under late sown conditions

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Abstract

A field experiment was conducted during *rabi* season of 2017-18 and 2018-19 at the Rajasthan College of Agriculture, Maharana Pratap University of Agricultural & Technology (MPUAT), Udaipur. The goal of this experiment was to compare various crop establishment methods in fusion with irrigation regime, hydrogel and salicylic acid application for yield and nutrient content. The outcome disclose that crop establishment methods had notable impact on yield components and nutrient content. The higher grain yield was recorded through FIRB sowing (46.82 q ha^{-1}) followed by line sowing and SWI sowing. Straw yield was recorded notably higher with line sowing (69.61 q ha^{-1}) over SWI sowing and found at par with FIRB sowing. SWI sowing recorded superior harvest index (41.3%) than line and FIRB sowing. SWI sowing in combination with irrigation at IW/CPE ratio 1.0 and application of hydrogel 10 kg ha^{-1} + salicylic acid 200 ppm recorded higher N, P and K content in grain as well as straw under late sown condition of wheat. It may concluded that FIRB sowing is appropriate method for wheat in late sown conditions for getting higher yield. Irrigation scheduling at IW/CPE ratio 1.0 recorded superior yield components compared to IW/CPE ratio 0.75. Application of hydrogel 10 kg ha^{-1} + salicylic acid 200 ppm observed notable dominant values of grain, straw and biological yield over others and found at par with salicylic acid 200 ppm.

Keywords: Crop establishment, irrigation regime, agrochemicals, hydrogel and salicylic acid

Introduction

Wheat is a grass widely cultivated for its seed, a cereal grain which is a worldwide staple food. The many species of wheat together make up the genus *Triticum*; the most widely grown is common wheat (*Triticum aestivum*). Global production of the wheat is, next only to maize and considered as foremost food of the people. The highest average productivity of wheat is obtained by United Kingdom (79.0 q/ha), followed by 78.0 q ha/ha in Germany and 7.5 q/ha in France. In India, it was grown on an area of 29.9 M ha, with a production of 107 million metric tons with an average productivity of 34.0 q/ha (Government of India. 2019-20) [6].

Crop establishment method has a significant impact on water, N and P absorption, energy savings and soil compaction (Trodson *et al.* 1989) [19]. Absorption of photo synthetically active radiations has also been observed to be affected by crop establishment methods (Lal *et al.* 1991) [12]. Various crop establishment method have dissimilar reaction undergoing numerous experiment conditions. Hassan and Hassan (1994) [8] have disclosed that wheat sowing in furrows provide higher grain, straw and biological yield. Özberk *et al.* (2009) [15] stated that planting methods plays a significant role in yield. In India, wheat is sown through broadcasting on a vast area in intensive cropping systems. Broadcasting sowing system not only needed more seed rate but also evaluated with poor yields. Thus assessment of better sowing methods is crucial for succeeding directions. Water is an invaluable input which plays crucial part in assertive production since it is necessary to conserve it through appropriate way of irrigation to maintain high turgidity, nutrient absorption and metabolic process of the plant. High-rise temperature stress is considered as main factor for looming or yield loss for agricultural crops. The late sowing after 20th November increased temperature reasoned for hastening of flowering and maturity in wheat crop by 30 days in late sowing as compared to normal sowing circumstances. Karim *et al.* (2011) [11] stated that the high application of salicylic acid improve in yield and nutrient content in wheat.

Thus present study was regulated to assess the efficacy of various crop establishment methods, irrigation regimes and agrochemical application on yield components and nutrient content of wheat.

Material and Methods

The present field experiment was conducted during *rabi* 2017-18 and 2018-19 seasons at the experimental farm of Rajasthan College of Agriculture, MPUAT, Udaipur to estimate the outcome of various crop establishment methods, irrigation regime, hydrogel and salicylic acid application on grain yield components and nutrient content of wheat. The area is situated at 24˚35’ N Latitude, 73˚42’ E Longitude with an altitude of 582 m above mean sea level. The area receives 700-900 mm rainfall.

The investigation was carried out split plot design with three replications, using plot size of 5.4 x 4.6 m. Fertilizer amount of NPK at the rate of 90-35-0 Kg ha^{-1} was put in to all the experiment plots. Wheat variety Raj-4238 was tested, at the rate of 125 kg ha^{-1} seed rate for line, 84 kg ha^{-1} for FIRB and 20 kg ha^{-1} for SWI sowing using following sowing methods, irrigation scheduling and agrochemicals application for assessment.

(A) Crop establishment methods

1. Line sowing at 20 cm
2. Furrow Irrigated Raised Bed (FIRB) raised beds (60 cm) altering with furrows (30 cm) prepared and 3 rows of wheat were planted on the bed.
3. System of wheat intensification (SWI) at Row x Row 20 cm, Plant x Plant 20 cm with 2 seeds hill-1

(B) Irrigation regime (IW/CPE ratio)

1. 1.0
2. 0.75

(C) Agro-chemicals

1. Water spray
2. Hydrogel 10 kg ha-1
3. Salicylic acid 200 ppm
4. Hydrogel 10 kg ha-1 + Salicylic acid 200ppm

* Hydrogel soil application done at the time of sowing or before irrigation

* Foliar spray of salicylic acid done at 55 and 75 DAS

The grain and straw samples from the produce of each plot were collected and oven dried at 60˚C to obtain constant weight. The samples were grinded to pass through 40 mesh sieve. The sample was analyzed for N (Lindner 1944) [13], P (Richards, 1968) [17] and K (Jackson, 1973) [10] content in grain and straw.

Results and Discussion

Effect of sowing methods

Data (Table 1) indicates that the maximum grain yield of 46.8 q ha^{-1} was obtained with FIRB sowing which was significantly superior over line sowing (44.2 q ha^{-1}) and SWI (39.3 q ha^{-1}) by 5.0 and 19.1 per cent, respectively. Further, line sowing also gave significantly higher grain yield over SWI by 12.5 per cent. Data revealed that line (69.6 q ha^{-1}) and FIRB (69.2 q ha^{-1}) sowing reported significantly increased straw yield over SWI sowing by 24.9 and 24.1 per cent, respectively. Finding of experiment indicate that FIRB (115.9 q ha^{-1}) and line (113.8 q ha^{-1}) sowing described notable higher biological yield over SWI by 22.1 and 19.8 per cent, respectively. Facts indicates that SWI sowing reported significantly higher harvest index over line and FIRB sowing by 6.5 and 2.5 per cent, respectively. Hossain (2006) [9] reported that superior grain yield of wheat crop with FIRB sowing was due to improvement in yield components. They further described that increase in these yield components were due to greater and efficient utilization of moisture, solar radiation and nutrients available into soil solution. These results are in agreement with Hossain *et al.*, (2006) [9], Alam *et al.* (2007) [1] and Özberk *et al.* (2009) [15].

It is evident from data in (Table 2) that SWI sowing recorded higher N content (1.760%) in grain over line sowing. Data shows that maximum N content in straw was recorded by SWI sowing (0.516%) followed by FIRB (0.512%) and line sowing (0.506%). Data shows that P content in grain and straw was reported with the pattern of SWI>FIRB>line sowing. Data divulge that higher K content (0.567%) in grain was recorded higher by SWI sowing over line sowing. Fahong *et al.* (2004) [5] delineate that nitrogen use efficiency could be improve by 10% or more in FIRBs sowing methods because of healthier microclimate due to the depletion in canopy humidity within the field which minimize crop lodging and dwindle the occurrence of some wheat diseases. Chatterjee *et al*. (2016) [2] observed that SWI sowing recorded higher NPK uptake as compared to conventional sowing which could be due to good vegetative and reproductive growth under SWI method.

Effect of Irrigation scheduling (IW/CPE ratio)

Irrigation at IW/CPE ratio 1.0 appear remarkable elevated grain (45.8 q ha^{-1}), straw (66.9 q ha^{-1}), biological yield (112.7 q ha^{-1}) and harvest index (40.7%) over IW/CPE ratio 0.75 by 11.4, 6.7, 10.0 and 2.7 per cent, respectively. The superior growth and yield parameters with higher level of irrigation may be due to ambient environment for root and shoot growth and higher availability of soluble nutrients to the plants and sufficient moisture available to the crop in the soil throughout growing period specifically at critical stages of crop. Therefore, it is confirmed that IW/CPE ratio at 1.0 maintained enough soil moisture at growth stages of wheat to maintain the physiological, structural and metabolic requirements of wheat apart from meeting out the required evapo-transpiration demand. These results are in great concurrence with Rehman *et al.* (2000) and Saren *et al.* (2004) [18]. It is well established that any condition of water stress to plants is normally linked with lower growth and yield performance (Mukharjee and Ghosh, 2006) [14].

Irrigation at IW/CPE ratio 1.0 recorded superior N content in grain and straw over IW/CPE ratio 0.75 by 2.70 and 7.09 per cent, respectively. Data stipulated that P content in grain as well as straw was recorded higher with irrigation at IW/CPE ratio 1.0 compared to IW/CPE ratio 0.75. K content in grain was not influenced significantly by irrigation scheduling but K content in straw was recorded higher by SWI sowing. The nutrient availability decreased in wheat plants as soil moisture lower which may be due to lessen the solubility of minerals in the soil where the films are thin and the path length of movement increases; hence, movement of cations and anions to root is lower. Moreover, high tension put a physiological effect on root, elongation, turgidity and number of root hairs diminish with increasing tension (Gunes *et al*, 2007) [7].

Effect of agrochemical spray

Data shows that hydrogel 10 kg/ha + salicylic acid 200 ppm announced notable higher grain yield (45.3 q ha^{-1}) over water spray, hydrogel 10 kg/ha and salicylic acid 200 ppm by 9.3, 5.2 and 3.1 per cent, respectively. Further, salicylic acid 200 ppm and hydrogel 10 kg/ha gave significantly higher grain yield over water spray by 6.1 and 3.9 percent, respectively. Data divulge that hydrogel 10 kg/ha + salicylic acid 200 ppm (66.9 kg ha^{-1}) was found notable towering straw yield over water and hydrogel 10 kg/ha by 6.8 and 4.0 per cent, respectively. Data indicates that hydrogel 10 kg/ha + salicylic acid 200 ppm was reported superior biological yield (112.3 q ha^{-1}) over water spray and hydrogel 10 kg/ha by 7.8 and 4.5 per cent, respectively and found at par with salicylic acid 200 ppm which was also found significantly superior over water spray by 4.9 per cent. Data indicates that hydrogel 10 kg/ha + salicylic acid 200 ppm and salicylic acid 200 ppm was outlined giant harvest index by 1.4 and 1.2 per cent, respectively. This could be due to providing sufficient moisture to plants for photosynthesis and respiration activities and might be due to due to higher moisture availability with hydrogel supplication. These results are in harmony of Karim *et al.*, (2011) [11], Chouhan *et al.* (2017) [3] and Dar and Ram (2017) [4]. Data shows that hydrogel 10 kg ha^{-1} + salicylic acid 200 ppm recorded higher N content by grain over water spray and hydrogel 10 Kg ha^{-1} by 1.7 and 1.1 per cent, respectively. Further, salicylic acid 200 ppm also recorded higher N content over water spray. Hydrogel 10 kg ha^{-1} + salicylic acid 200 ppm reported higher N content by straw over water spray, hydrogel 10 kg ha^{-1} and salicylic acid 200 ppm by 4.6, 3.2 and 2.0 per cent, respectively. An assessment of data reveals that agro-chemicals application did not register much significant variation in the phosphorus content in grain and straw. Data reveals that agro-chemicals application of hydrogel 10 kg ha^{-1} + salicylic acid 200 ppm recorded higher K content over water spray. These results are in agreement with Tyagi *et al.* (2015) [20] finding in which notable increase in N, P and K uptake by wheat grain and straw was observed with higher level of nutrients and hydrogel. It was due to more uptake of NPK by crop and its assimilation in grain and straw yield under 100% NPK with 5 kg hydrogel ha^{-1}. The positive impact of nutrient uptake in grain and straw seems to be on account of better development of canopy which might have maintained adequate supply of metabolites for better growth.

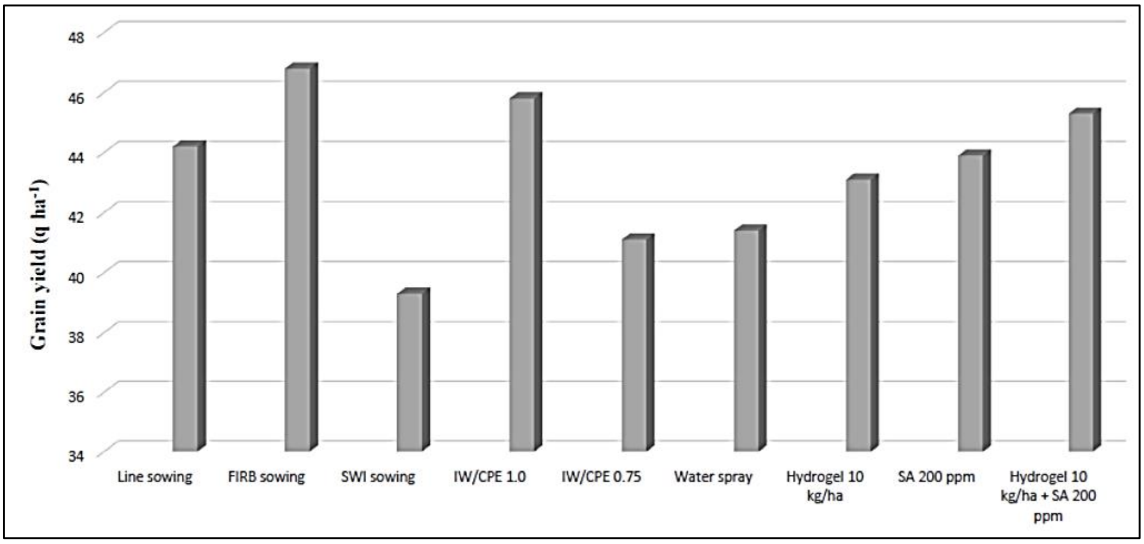

Fig 1: Effect of crop establishment methods, irrigation regime, and Agrochemical application on grain yield of Wheat

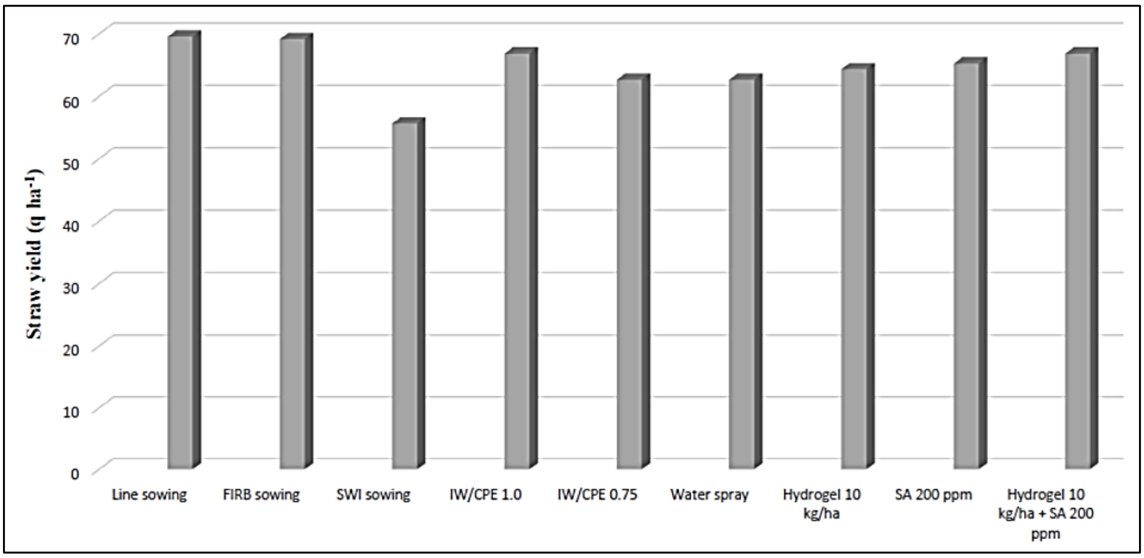

Fig 2: Effect of crop establishment methods, irrigation regime, and Agrochemical application on straw yield of Wheat

Table 1: Effect of crop establishment methods, irrigation regime, hydrogel and salicylic acid application on yield components under late sown wheat

Treatments	Grain Yield (q ha^{-1})	Straw Yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest Index (%)
Crop establishment methods				
Line	44.2	69.6	113.8	38.8
FIRB	46.8	69.2	115.9	40.3
SWI	39.3	55.7	95.0	41.3
SEm+	0.54	0.77	0.63	0.11
CD at 5%	1.59	2.27	1.87	0.34
Irrigation regime				
1.0 IW/CPE	45.8	66.9	112.7	40.67
0.75 IW/CPE	41.1	62.7	103.8	39.60
SEm+	0.44	0.63	0.52	0.09
CD at 5%	1.30	1.85	1.52	0.28
Agrochemicals				
Water spray	41.4	62.7	104.1	39.8
Hydrogel 10 kg/ha	43.1	64.4	107.5	40.1
Salicylic Acid 200 ppm	43.9	65.3	109.2	40.3
Hydrogel 10 kg/ha + Salicylic Acid 200 ppm	45.3	66.9	112.3	40.4
SEm+	0.47	0.75	1.18	0.13
CD at 5%	1.32	2.09	3.30	0.35

Table 2: Effect of crop establishment methods, irrigation regime, hydrogel and salicylic acid application on nutrient content under late sown wheat

Treatments	Nutrient content (%)					
	N		P		K	
	Grain	Straw	Grain	Straw	Grain	Straw
Crop establishment methods						
Line	1.746	0.506	0.332	0.158	0.561	1.317
FIRB	1.755	0.512	0.334	0.160	0.564	1.322
SWI	1.760	0.516	0.337	0.163	0.567	1.323
SEm+	0.005	0.001	0.001	0.001	0.002	0.003
CD at 5%	0.013	0.003	0.003	0.002	0.006	NS
Irrigation regime						
1.0 IW/CPE	1.777	0.529	0.336	0.162	0.566	1.324
0.75 IW/CPE	1.731	0.494	0.332	0.158	0.562	1.317
SEm+	0.004	0.001	0.001	0.000	0.002	0.002
CD at 5%	0.011	0.003	0.002	0.001	NS	0.007
Agrochemicals						
Water spray	1.740	0.501	0.332	0.157	0.562	1.315
Hydrogel 10 kg/ha	1.749	0.508	0.334	0.160	0.564	1.319
Salicylic Acid 200 ppm	1.758	0.514	0.335	0.161	0.565	1.322
Hydrogel 10 kg/ha + Salicylic Acid 200 ppm	1.769	0.524	0.337	0.163	0.566	1.326
SEm+	0.005	0.001	0.001	0.001	0.002	0.003
CD at 5%	0.013	0.003	0.003	0.002	NS	0.009

Conclusion

The current research indicates that improved crop establishment methods, appropriate irrigation regime (IW/CPE ratio) and hydrogel and salicylic acid application give better results compared to the old crop establishment methods, poor irrigation management and chemical spray to wheat crop. Consequently, FIRB and line sowing is advised for obtaining superior grain yields with maintain soil health and quality under resource sufficient conditions.

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