Indian Journal of Agronomy **62** (1): 45–48 (March 2017)

Research Paper

Effect of fertility levels and antitranspirants on productivity and profitability of wheat (*Triticum aestivum*) varieties

BALWAN[1], L.R. YADAV[2], H.P. VERMA[3], RAJESH KUMAR[4] AND S.S. YADAV[5]

Sri Karan Narendra Agriculture University, S.K.N. College of Agriculture, Jobner, Jaipur, Rajasthan 303 329

Received : December 2016; Revised accepted : March 2017

ABSTRACT

A field experiment was conducted at S.K.N. College of Agriculture, Jobner (Jaipur), Rajasthan, during 2 consecutive winter (*rabi*) seasons 2013–14 and 2014–15, to study productivity and profitability of wheat (*Triticum aestivum* L.) as affected by fertility and antitranpirants. The results revealed that variety 'Raj 3077' showed significantly higher values of growth parameter, viz. plant height, dry-matter accumulation, crop-growth rate (CGR) and relative growth rate (RGR), yield-attributing characters (number of effective tillers and number of grains/spike) and grain yield (4.12 t/ha) and straw yield (5.45 t/ha) than 'Raj 3765'. The highest net returns of ₹66,220/ha with benefit: cost (B:C) ratio of 3.42 was obtained with 'Raj 3765' wheat. Application of 100% recommended dose of fertilizer (RDF) resulted in significantly higher growth parameter (plant height, dry-matter accumulation, CGR and RGR), yield-attributing characters (number of effective tillers, number of grains/spike, ear length and 1,000-grain weight) and grain yield (4.88 t/ha) and straw yield (6.41 t/ha). The highest net returns of ₹81,290/ha with benefit: cost ratio of 3.84 were obtained application of 100% RDF. The foliar application of cycocel @ 1,000 ppm resulted in significantly higher growth parameter like dry-matter accumulation, CGR and RGR, yield-attributing characters like number of effective tillers, number of grains/spike and 1,000-seed weight and grain yield (4.04 t/ha) and straw yield (5.32 t/ha) in 'Raj 3765'. However, plant height was significantly decreased owing to the antitranspirants. The application of cycocel @ 1,000 ppm gave the highest net returns of ₹64,960/ha with benefit: cost ratio of 3.43.

Key words: Antitranspirants, Fertility levels, Varieties, Wheat

Wheat (*Triticum aestivum* L.), the crop which triggered green revolution in the Indian subcontinent is the second most important cereal crop next to rice. India stands second among wheat-producing countries with respect to area and production. In India, wheat was grown over an area of 30.6 million ha with production of 96.50 million tonnes and productivity of 3,153 kg/ha (GoI, 2016). In Rajasthan, the area under wheat is about 3.1 million ha with a production of about 10.4 million tones, representing average productivity of 3,369 kg/ha (GoR, 2016). The reason for low productivity is the non-adoption of high yielding varieties and poor agronomic practices.

Recommended dose of fertilizers is a vitally important to supply plant nutrient soil of N and P deficient soils of India, particularly in the loamy sand soils of semi-arid regions of Rajasthan. Nitrogen is an essential constituent of plant proteins and chlorophyll and is present in many other compounds of greater physiological importance in plant metabolism such as nucleotides, phosphtides, enzymes, hormones, vitamins etc. Soil moisture is the major constraint in the dryland agriculture. Water loss from crop plant can be reduced either by reducing the loss of water with the help of an antitranspirant such as PMA (stomata closing type) or suppressing the overall growth of the plants by using a growth retardant such as cycocel. Antitranspirants, in general, reduce the transpiration loss of water occurring mainly through leaf surface. Hence, field investigation was undertaken to find out the effect of fertility levels and antitranspirants on wheat.

MATERIALS AND METHODS

A field experiment was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner (Jaipur), during 2 consecutive winter (*rabi*) seasons 2013–14 and 2014–15 with wheat grown on irrigated loamy sand soil of semi-arid eastern plain zone of Rajasthan. The experiment consisting of 2 varieties 'Raj 3077' and 'Raj 3765', 3 fertility

Based on a part of Ph.D thesis of the first author submitted to Sri Karan Narendra Agriculture University, Jobner, Rajasthan in 2017 (unpublished)

[1]**Corresponding author's Email:** balwanchuru1986@gmail.com
[2]Professor and Head, [4,5]Professor, [1,3]Ph.D Scholar, Department of Agronomy, SKN Agriculture University, Jobner

levels, viz. control, 75% recommended dose of fertilizer (RDF) and 100% RDF, and 4 antitranspirants control, cycocel @ 1,000 ppm, PMA @ 250 ppm and kaolin 5%), thereby making 24 treatment combinations were replicated 3 times in split-plot design keeping varieties and fertility levels in main plots and antitranspirants in sub-plots.

The soil was loam sandy in texture with *p*H 8.2, organic carbon 0.18%, available N 131.7 kg/ha and available P 14.83 kg/ha. The soil-moisture content at field capacity and permanent wilting point was 12.7 and 2.64% respectively, with bulk density 1.50 Mg/m^3 of 0–15 cm layer. The maximum temperature ranged from 35.1 to 18.5 ^{o}C during 2013–14 and 35.5 to 18.2 ^{o}C during 2014–15. The relative humidity ranged between 77 and 44% during 2013–14 and 82 and 47% during 2014–15. The average sunshine fluctuated between 09.4 and 04.9 hours/day during 2013–14 and 09.1 and 03.1 hours during 2014–15. The total rainfall received during the first crop season (2013–14) was 55.4 mm which was received mostly at the flowering stage, whereas during the second crop season (2014–15) it was 60.0 mm that too at the end of crop season.

RESULTS AND DISCUSSION

Growth parameters

Variety 'Raj 3077' recorded significantly higher plant height at harvesting, dry-matter accumulation/m row length at harvesting, CGR at 90 days to harvesting and CGR at 90 days to harvesting, representing an increase of 12.6, 13.3, 10.9 and 31.2%, respectively, over 'Raj 3765' (Table 1). Hence for realizing growth potential of a plant to the fullest extent, its major growth stages should coincide with required sequence of climatic conditions. Thus, the inherent capabilities of variety 'Raj 3077' with enhanced vegetative growth with optimum duration available under prevailing climatic conditions might have helped the plants to efficiently utilize prevailing climatic conditions (Mali and Choudhary, 2010; Kalita *et al*., 2011).

The fertility levels resulted in significant higher plant height at harvesting, dry-matter accumulation/m row length at harvesting, CGR at 90 days to harvesting and CGR at 90 days to harvesting during both the years and in pooled data, representing an increase of 22.0, 64.1, 66.0 and 58.5% respectively, over the control (Table 1). Fertilizers improve the physical, chemical and biological properties of soil and supply almost all the essential plant nutrients for growth and development of plants. The results of the present investigation are in close conformity with those of Singh *et al.* (2003) and Singh *et al.* (2013).

Data (Table 1) indicated that plant height was significantly reduced under treatment cycocel @ 1,000 ppm compared to the control during individual. Application of cycocel @ 1,000 ppm resulted in significantly higher dry-matter accumulation/m row length, CGR at 90 days to

Table 1. Effect of varieties, fertility levels and antitranspirants on growth and yield attributes of wheat (pooled data of two years)

Treatment	Plant height at harvest (cm)	Dry matter accumulation/m row length (g)	CGR at 90 days to at harvest (g/m^2/day)	RGR at 90 days to at harvest (mg/g/day)	Effective tillers/m row length	Ear length (cm)	Grains/ spike	1,000-weight (g)
Varieties								
'Raj 3077'	97.6	231.5	5.92	9.21	76.7	8.51	42.5	35.8
'Raj 3765'	86.7	204.3	5.34	7.03	73.7	8.68	41.3	38.3
SEm±	0.8	1.0	0.16	0.29	0.6	0.09	0.2	0.3
CD (P=0.05)	2.4	3.1	0.48	0.85	1.8	NS	0.7	0.9
Fertility levels								
Control	81.3	160.4	4.35	6.20	68.7	7.26	33.2	33.9
75% RDF	95.9	230.2	5.54	8.33	77.2	8.87	44.1	37.2
100% RDF	99.3	263.3	7.22	9.83	79.6	9.65	48.5	39.9
SEm±	1.0	1.3	0.20	0.35	0.8	0.11	0.3	0.4
CD (P=0.05)	2.9	3.8	0.59	1.05	2.2	0.31	0.8	1.1
Antitranspirants								
Control	93.9	190.4	5.36	7.39	73.1	8.13	40.6	35.8
Cycocel @ 1000 ppm	90.5	234.5	6.56	8.79	76.6	8.98	43.0	38.0
PMA @ 250 ppm	91.4	222.6	5.54	8.10	75.0	8.46	41.3	36.7
Kaolin 5%	92.7	224.3	5.60	8.20	76.0	8.81	42.7	37.5
SEm±	0.9	1.1	0.19	0.34	0.5	0.05	0.1	0.4
CD (P=0.05)	2.6	3.2	0.52	0.95	1.3	0.13	0.4	1.1

CGR, Crop-growth rate; RGR, relative growth rate; RDF, recommended dose of fertilizer

harvesting and CGR at 90 days to harvesting during both the years of study, representing an increase of 23.2, 26.0 and 18.9% respectively, over control on pooled mean basis. However, application cycocel @ 1,000 ppm being at par with kaolin 5% CGR at 90 days to harvesting and CGR at 90 days to harvesting during both the years of study and in pooled data. The dry weight of reproductive parts increased continuously throughout the growing period owing to antitranspirant treatments. The enhanced dry weight of reproductive parts by antitranspirant application was owing to increased spikes/plant and also efficient translocation of assimilates from leaf and stem to reproductive parts which was similar with findings of Lord and Wheeler (1981) in wheat.

Yield attributes and yield

'Raj 3077' wheat recorded significantly higher number of effective tillers/m row length and number of grains/spike, 1,000-seed weight over 'Raj 3765' during both the years of study and in pooled mean and represented an increase of 4.1, 2.9 and 7.0% over variety 'Raj 3765' on pooled mean basis, but wheat varieties did not differ significantly in ear length during both the years of study and in pooled data. Variety 'Raj 3765' recorded significantly higher 1,000-seed weight over 'Raj 3077'. Data (Table 2) revealed that variety 'Raj 3077' recorded significantly higher grain yield and straw yield over 'Raj 3765' during both the years of study and in pooled mean and represented an increase of 12.0 and 9.9% over 'Raj 3765' on pooled mean basis, but wheat varieties did not differ significantly in harvest index during both the years of study and in pooled data. The increased parameters might have attributed to higher manufacture of food and its subsequent partitioning towards sink. The availability and supply of nutrients to formation ultimately increased the number of grains/spike and 1,000-grain weight. Similar findings were observed by Thakur (2009) and Singh *et al.* (2013) in wheat.

An application of 100% RDF recorded significantly higher effective tillers/m row length, number of grains/spike, ear length and 1,000-grain weight over the control during both the years of study and represented an increase of 15.9, 46.1, 33.0 and 17.7% control on pooled mean basis (Table 2). An application of 100% RDF recorded significantly higher grain yield, straw yield and harvest index over the control during both the years of study and in pooled mean and represented an increase of 103.3, 89.5 and 4.0% over the control on pooled mean basis.

The increased values of parameters might have attributed to higher manufacture of food and its subsequent partitioning towards sink. The availability and supply of nutrients to formation ultimately increased the number of grains/spike and 1,000-grain weight. Similar findings were observed by Thakur (2009) and Singh *et al.* (2013) in wheat.

An application of cycocel @ 1,000 ppm resulted in significantly higher effective tillers/m row length, grains/spike, ear length and 1,000-seed weight over the control and represented an increase of 4.7, 6.0, 10.4 and 6.3% over the control on pooled mean basis (Table 1). Data (Table 2) further revealed that an application of cycocel @ 1,000 ppm recorded significantly higher grain yield and straw yield of 'Raj 3077' over 'Raj 3765' during both the years of study and in pooled mean and represented an increase of 12.0 and 9.9% over the 'Raj 3765' on pooled mean basis, but all antitranspirants did not differ significantly in harvest index during both the years. The increase in yield might be owing to availability of sufficient mois-

Table 2. Effect of varieties, fertility levels and antitranspirants on yield (t/ha) and economics of wheat (pooled data of 2 years)

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index	Net returns ($\times 10^3$ ₹/ha)	Benefit: cost ratio
'Raj 3077'	4.12	5.45	42.87	66.22	3.42
'Raj 3765'	3.68	4.96	42.40	56.72	3.08
SEm±	0.07	0.10	0.34	1.51	0.05
CD (P=0.05)	0.20	0.29	NS	4.44	0.16
Control	2.40	3.38	41.53	31.09	2.29
75% RDF	4.41	5.82	43.18	72.02	3.62
100% RDF	4.88	6.41	43.19	81.29	3.84
SEm±	0.08	0.12	0.42	1.84	0.07
CD (P=0.05)	0.24	0.36	1.24	5.44	0.20
Control	3.65	4.96	42.29	57.95	3.24
Cycocel @ 1,000 ppm	4.04	5.32	42.93	64.96	3.43
PMA @ 250 ppm	3.90	5.25	42.46	58.51	2.90
Kaolin 5%	4.00	5.30	42.86	64.45	3.42
SEm±	0.04	0.07	0.34	0.89	0.03
CD (P=0.05)	0.12	0.19	NS	2.52	0.09

ture because of reduced transpirational loss and increased translocation of photosynthates to the sink. The 1,000-grain weight showed significant influence owing to the application of kaolin. Application of antitranspirants resulted in significantly higher 1,000-grain weight over the control. Similar results were observed by Brahma *et al.* (2007) and Singh *et al*. (2008).

Economics

Variety 'Raj 3077' gave significantly higher net returns and benefit: cost ratio during both the years and in pooled data over 'Raj 3765'. Variety 'Raj 3077' showed an increase of 16.8% in net returns over 'Raj 3765' pooled mean basis. Our results confirm the results of Alam *et al.* (2013). The application of 100% RDF had significant effect on net returns and benefit: cost ratio during both the years of study and on pooled analysis. Application of 100% RDF resulted in 12.9 and 161.4% in net returns over 75 % RDF and the control on pooled mean basis**.** These results confirm the findings by Singh *et al*. (2010). Foliar application of antitranspirants also significantly increased the net return and B:C ratio of wheat over the control. Application of cycocel @ 1,000 ppmrecorded an increase of 12.1% in net returns over the control. This treatment also recorded higher B:C ratio (3.43) over the control. The B:C ratio was higher in cycocel @ 1,000 ppm, which was at par with kaolin 5% (3.42). The result supports the findings of Brahma *et al.* (2007).

Combined effects of fertility levels and antitranspirants on number of effective tillers/m row length

The interactive effect of fertility levels and antitranspirants on number of effective tillers/m row length of wheat was found significant (Table 3). Foliar application of cycocel @ 1,000 ppm with 100% recommended dose of fertilizers (RDF) recorded significantly higher number of effective tillers/m row length over rest of the treatments. Application of 1,000 ppm cycocel with 100% resulted in dose of fertilizers (RDF) represented a significant increase of 22.3% over the control (without any fertility level and antitranspirants).

Table 3. Combined effects of fertility levels and antitranspirants on number of effective tillers/m row length (pooled mean)

Treatment	Fertility levels		
	Control (F_1)	75% RDF (F_2)	100% RDF (F_3)
Control (A_1)	66.91	74.30	78.19
Cycocel @ 1,000 ppm (A_2)	71.24	76.75	81.83
PMA @ 250 ppm (A_3)	67.53	78.14	79.33
Kaolin 5% (A_4)	69.16	79.65	79.28
F at same levels of A			
SEm±		0.40	
CD (P=0.05)		1.14	
A at same levels or different level of F			
SEm±		0.57	
CD (P=0.05)		1.73	

RDF, Recommended dose of fertilizer

It is concluded that wheat variety 'Raj 3077' performed better with application of 100% RDF and foliar spray of cycocel @ 1,000 ppm or kaolin 5% at 50 and 80 days after sowing (DAS). Combined effect of foliar application of cycocel @ 1,000 ppm with 100% recommended dose of fertilizers (RDF) recorded significantly higher number of effective tillers/m row length over rest of the treatments.

REFERENCES

Alam, M.P., Kumar, S., Naiyar, A., Kumari, Nargic, Lakra, R.K. and Tajwar, I. 2013. Performance of wheat varieties under different sowing dates in Jharkhand. *Journal of Wheat Research* **5**(2): 61–64.

Brahma, R., Janawade, A.D. and Palled, Y.B. 2007. Effect of irrigation schedules, mulch and antitranspirant on growth, yield and economics of wheat (cv. 'DWD 1006'). *Karnataka Journal of Agricultural Science* **20**(1): 6–9.

GoI, 2016. Agricultural Statistics at a Glance. Directorate of Economics and Statistics. Department of Agriculture and Cooperation, Ministry of Agriculture. http//dacnet.nic.in.

GoR, 2016. *Vital Agricultural Statistics, 2012–13*. Directorate of Agriculture, Government of Rajasthan, Jaipur. www.rajasthankirshi.org.in.

Kalita, P., Das, R. and Rabha, B.K. 2011. Growth and yield response of wheat genotypes to rainfed condition of Assam. *Indian Journal of Plant Physiology* **16**(1): 10–18.

Lord, K.A. and Wheeler, A.W. 1981. Uptake and movement of Chlormequat chloride applied to leaves of barley and wheat. *Journal of Experimental Biology* **32**: 599–603.

Mali, H. and Choudhary, J. 2010. Performance of bread wheat (*Triticum aestivum* L.) varieties under different row spacing. *Journal of Wheat Research* **4**(2): 55–57.

Singh, D., Singh, D.R., Nepalia, V. and Kumari, Amina. 2013. Argro-economic performance of dual purpose barley (*Hordeum vulgare* L.) varieties under varying seed rate and fertility levels. *Annals of Agricultural Research* **34**(3): 325–329.

Singh, P., Singh, P., Singh, K.N., Singh, R. and Raja, Waseem. 2010. Evaluation of wheat (*Triticum aestivum* L.) genotypes for productivity and economics under graded levels of nitrogen in temperate Kashmir. *Indian Journal of Agricultural Sciences* **80**(5): 380–384.

Singh, S.K. and Singh, K.P. 2003. Effect of long term use of fertilizers, lime and FYM on yield and nutrient uptake by wheat and soil properties. *Journal of Research* **15**(1): 85–87.

Singh, S.N., Khan, M.A., Singh, A.K. and Singh, O.P. 2008. Effect of antitranspirants on growth, biochemical, yield and yield components on wheat under stress conditions. *Progressive Agriculture* **8**(2): 273–277.

Thakur, D.R. 2009. Effect of organic and inorganic source of nutrients of rice–wheat cropping system. *Indian Journal of Agronomy* **53**(1): 32–36.