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Full Length Research Paper

Yield and yield attributes of wheat (*Triticum aestivum* L.) as influenced by agrispon and fertonic at varying level of fertility

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A field experiment was conducted during *rabi* seasons for two years at Agronomy Research farm, CCS HAU, Hissar to evaluate the effect of agrispon and fertonic on yield attributes and yield of wheat. Effective tillers, earhead length, spikelets earhead^{-1}, grains earhead^{-1}, grain and straw yield of wheat enhanced significantly with 120+60 Kg ha^{-1} N and P (100% of recommended dose). Fertilizer level failed to influence harvest index and test weight. Two spray of agrispon significantly @ 1 *l* ha^{-1}two application each at sowing and at 30 DAS enhanced effective tillers, spike length, spikelets spike^{-1}, grains spike^{-1}, grain, straw and biological yield over its one spray and control. Fertilizer use efficiency also increased with agrispon spray by 100% compared to the control (16.6 kg grain per kg nutrient). Fertonic remain at par with control in all parameters.

Key words: Agrispon, fertonic, fertilizer levels, heat, yield and yield attributes.

INTRODUCTION

The 'green revolution', which launched intensive use of high-yielding varieties of crops coupled with other inputs like chemical fertilizers and irrigation water, was both a success in boosting food supply and at the same a challenge in terms of combating the threat of imbalance fertilization the primary cause of soil degradation and decline in soil fertility. The real challenge is to keep the pace of production under condition of decreasing per capita arable without losing land productivity. As benchmark for this great challenge, researchers have estimated that the food output of 200 million tonnes and fertilizer consumption of 17 million tonnes would result in nutrient removal of 25 to 27 million tonnes leaving a nutrient gap of about 10 million tones (Rao and Reddy, 2006 and Swarup and Ganeshamurthy, 1998). The country's researchers and policy-makers have considered several soil and plant nutrient management options to sustain soil fertility in their continuing effort to close the food and population gaps, which primarily include the Integrated Nutrient Management, the balanced use of chemical based fertilizers and sourcing and processing all possible use of organic manures and biofertilizers, which improved livelihood opportunities of small farmers .

The stagnant situation in fertilizer consumption and higher negative nutrient balance are posing a threat to soil quality and sustainable agriculture. A cereal production of 5-10 t/ha/year in rice-wheat rotation, which is the backbone of India's food security removes 380-760 kg N-P_2O_5-K2O per hectare per year. Farmers generally apply 50 percent to 80 percent of this amount. Thus there is a gradual depletion of the inherent soil fertility (Rao and Reddy, 2006).

Agrispon is a natural; easy-to use and cost-efficient biostimulant that dramatically improves plant performance and/or yield. Derived from plant and mineral extracts this liquid concentrate is effective in any climate suitable for plant growth. It performs especially well where there is stress due to soil or weather conditions. It also increases the populations of beneficial micro-organisms which can significantly improve soil nutrient supply to roots. For instance, key plant macro nutrients such as nitrogen, sulphur and phosphorus all require micro-organisms in the root zone to make them more available to the plant. Many agronomic practices, however

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suppress these organisms and hence limit the nutrient supply to the roots, even in situations where adequate fertilizer has been applied. Such is the dependency of the root and soil ecosystem on soil micro-organisms. Root building phosphorus, in particular, is dependent on microbes for its release into the soil, especially in low or high pH soils. The use of Agrispon in plant fertility programs has led in many crop systems to large improvements in the efficiency of utilization of nutrients such as nitrogen and hence a concomitant reduction in application rate. The use of Agrispon in plant fertility programs has led in many crop systems to large improvements in the efficiency of utilization of nutrients such as nitrogen and phosphorus. Another benefit of increased micro-organism activity is improved soil structure. This, in turn, improves aeration, as well as water infiltration and percolation. The resultant increase in water intake limits runoff and soil erosion so that more nutrients and moisture are available to the plant. In addition, well structured soil with adequate nutrients helps plants withstand the rigors of environmental stress (Anonymous, 2012).

Fertonic, which is primarily used at the time of land preparation for improving the growth and development of various crops. It is hygienically formulated using optimum quality Chemicals and ingredients, which are procured from established vendors of the industry. It Promotes all over growth and development of crop plants right from seed germination and emergence, improves harvest in both quantity and quality, supply primary, secondary and micro- nutrients and Increases efficiency of applied nitrogen (Anonymous, 2013).

Looking to this situation of heavy nutrient removal, an experiment was planned to evaluate the efficacy of agrispon and fertonic (Bio products) at varying level of fertility in wheat. Since these bio products are reported to lower down the chemical fertilizer demand.

MATERIALS AND METHODS

An experiment was conducted during *rabi* season for two years at Agronomy Research Farm of CCS HAU Hisar. Soils of experimental area were sandy loam in texture, alkaline in reaction (8.15), low in organic carbon(0.35%) and nitrogen(171.4 kg ha^{-1}), and medium in available phosphorus(13.23 kg ha^{-1}), and high in available potassium(368.1 kg ha^{-1}). The experiment was laid out in split plot design keeping five fertilizer levels (0, 25, 50, 75 and 100% (RDF) recommended dose of fertilizer N and P_2O_5 i.e. 120 +60 Kg ha^{-1}.) in main plot and six Bio product levels viz. No bio product, Agrispon @ 1 *l* ha^{-1} one application at sowing, agrispon @ 1 *l* ha^{-1}two application each at sowing and at 30 DAS, Fertonic 60,120 and 180 Kg ha^{-1} in sub plot with three replications. Fertonic is a bio organic soil enricher containing organic carbon 16-18%, nitrogen-1.5-1.8%, phosphorus 1.25%, potassium 1.05%, Ca-2%, Mg.0.7%, S-0.5%,Fe-0.5%, Zn – 705ppm, Mn-740ppm, Cu-345ppm and also containing beneficial micro-organism (Anonymous, 2012). Fertonic was applied as basal at the time of sowing. Agrispon first spray was made at sowing and second at 30 DAS. Urea and SSP were used as fertilizer material, phosphorus was applied as basal and nitrogen half as basal and half at first irrigation. The wheat cv. HD-2329 was used as test crop and in line keeping row to row distance 23.5 cm as per recommendation.

Effective tillers per meter raw length were counted from two randomly selected marked rows from each plot at harvest. Among these two randomly selected marked rows ten spikes were selected for measuring spike length and counting number of spike lets per spike and number of grains per spike. For measuring test weight a composite sample of grains was taken from the produce of each plot and weight of 1000 grains was taken at 8% moisture level.

Harvest index (%) was calculated by the following formula-

Harvest index (%)= (Grain yield/ Biological yield)x 100 (1)

Fertilizer use efficiency (kg grain per kg of nutrient) was calculated by the following formula-

Fertilizer use efficiency (kg grain per kg of nutrient)=(Grain yield in treated plot- Grain yield in untreated plot)/ Nutrint applied in treated plot (2)

RESULTS AND DISCUSSION

Yield attributes

In the present investigation application of 100% of recommended dose of N and P (120+60 Kg ha-1) significantly (at 5% level of significance) improved various yield attributing parameters over its respective lower levels viz. effective tillers, spike length, spike lets $spike^{-1}$ and grains $spike^{-1}$ (Table-1). The respective increase in these parameters was 80.7 and 78.3; 69.0 and 64.5; 91.2 and 75.7 and 91.2 and 75.7 percent with 120+60 kg ha^{-1} N and P_2O_5 over control in 1st and 2nd Year respectively. The favourable effect of increased fertility level on yield attributes may be ascribed to the availability of higher amount of nutrients throughout the growing period which resulted improved plant vigour and consequently better yield attributes. Singh and Prasad (1998) also reported similar findings in wheat crop.

The application of agrispon @ 1 *l* ha^{-1} each at sowing and 30 DAS significantly improved all yield attributes except test weight over its single spray and control. The significant improvement in yield attributes may be due to beneficial effect of agrispon on crop growth and various physiological parameters that affected yield attributing characters positively. It may also be due to improved meta-

Table 1. Effective tillers m^{-1} row length at harvest, earhead length, spikelet $earhead^{-1}$, grains $earhead^{-1}$ and test weight as influenced by fertilizer levels and bioproducts.

Treatments	Effective tillers m^{-1} row length		spike length(Cm)		Spikelet $spike^{-1}$		Grains $earhead^{-1}$		Test weight(g)	
	Ist Year	IInd Year	Ist Year	IInd Year	Ist Year	IInd Year	Ist Year	IInd Year	Ist Year	IInd Year
Fertilizer levels (NP kg ha-1)										
Control	70.1	73.7	5.8	6.2	9.1	10.7	27.3	32.1	30.1	30.2
25% RDF	85.5	88.5	6.9	7.3	12.8	13.2	38.4	39.7	30.1	30.3
50% RDF	101.3	102.8	7.7	8.8	14.4	15.0	43.3	44.9	30.3	30.5
75%RDF	116.2	119.5	8.9	9.4	16.1	17.1	48.4	51.4	30.6	30.8
100% RDF(120+60)	126.7	131.4	9.8	10.2	17.4	18.8	52.2	56.4	30.8	31.0
SEm±	2.0	2.0	0.2	0.2	0.3	0.3	0.9	0.9	0.9	0.9
CD (0.05)	6.4	6.4	0.6	0.6	1.0	1.0	3.0	3.0	NS	NS
Bioproducts										
Control	91.3	95.8	7.0	7.7	12.7	13.6	38.0	40.9	30.2	30.0
Agrispon 1 *l* ha^{-1} at sowing	107.1	107.6	8.3	9.0	14.6	16.0	43.7	48.0	30.3	30.4
Agrispon 1 *l* ha^{-1} each at sowing & 30 DAS	123.2	126.2	10.1	10.2	18.1	18.2	54.4	54.7	30.4	30.5
Fertonic 60 kg ha^{-1}	92.7	96.1	7.1	7.8	12.8	14.0	38.4	42.1	30.3	30.6
Fertonic 120 kg ha^{-1}	92.5	96.5	7.0	7.6	12.9	14.0	38.6	41.9	30.5	30.9
Fertonic 180 kg ha^{-1}	92.8	96.7	7.2	7.9	12.7	13.9	38.2	41.7	30.6	31.2
SEm±	2.0	2.1	0.14	0.14	0.3	0.3	0.8	0.8	0.8	0.6
CD (0.05)	5.5	5.8	0.4	0.5	0.8	0.8	2.3	2.5	NS	NS

RDF(Recommended dose of fertilizer).

Table 2. Grain and straw yield (kg ha^{-1}), harvest index (%) and fertilizer use efficiency (kg grain kg^{-1} nutrient) as influenced by fertilizer levels and bioproducts.

Treatments	Grain yield			Straw yield			Harvest index		Fertilizer use efficiency	
	Ist Year	IInd Year	Polled mean	Ist Year	IInd Year	Polled	Ist Year	IInd Year	Ist Year	IInd Year
Fertilizer levels (NP kg ha-1)										
Control	1655	1782	1719	2449	2635	2542	40.3	40.2	-	-
25% RDF.	2824	2943	2883	4227	4345	4286	40.1	40.3	26.0	25.8
50% RDF.	3830	3932	3881	5682	5788	5735	40.3	40.5	24.2	23.9
75% RDF.	4485	4577	4531	6563	6646	6605	40.6	40.8	21.0	20.7
100% RDF.(120+60)	4976	5067	5021	7350	7259	7305	40.5	41.1	18.5	18.3
SEm±	73	93	76	115	171	120	1.1	0.9	-	-
CD (0.05)	238	305	247	377	558	390	NS	NS	-	-
Bioproducts										
Control	3147	3257	3202	4672	4860	4766	40.3	40.0	16.6	16.4
Agrispon 1 *l* ha^{-1} at sowing	4013	4119	4066	5986	6074	6030	40.1	40.4	26.2	26.0
Agrispon 1 *l* ha^{-1} each at sowing & 30 DAS	4670	4769	4719	6953	6962	6958	40.2	40.6	33.5	33.2
Fertonic 60 kg ha^{-1}	3170	3269	3219	4681	4763	4722	40.3	40.6	16.8	16.5
Fertonic 120 kg ha^{-1}	3160	3263	3211	4620	4697	4659	40.5	40.9	16.7	16.5
Fertonic 180 kg ha^{-1}	3164	3285	3224	4613	4651	4632	40.6	41.2	16.8	16.7
SEm±	67	74	71	112	55	84	0.8	0.6	-	-
CD (0.05)	194	210	202	320	156	238	NS	NS	-	-

Table 3. Interaction effect of fertilizer levels and bioproducts on effective tillers m^{-1} row length of wheat at harvest.

Bioproducts	**Fertilizer levels (NP kg ha-1)**				
	Control	25% RDF.	50% RDF	75% RDF	100% RDF (120+60)
Ist Year					
Control	61.2	76.3	93.1	106.5	119.6
Agrispon 1 / ha^{-1} at sowing	81.4	95.8	109.5	123.1	125.7
Agrispon 1 / ha^{-1} each at sowing & 30 DAS	92.7	106.7	120.4	144.7	151.7
Fertonic 60 kg ha^{-1}	61.7	78.0	94.9	107.9	121.1
Fertonic 120 kg ha^{-1}	61.5	77.8	94.6	107.7	120.8
Fertonic 180 kg ha^{-1}	61.9	78.2	95.1	107.2	121.4
IInd Year					
Control	66.5	80.0	95.5	111.8	125.2
Agrispon 1 / ha^{-1} at sowing	80.0	94.4	108.9	122.8	132.1
Agrispon 1 / ha^{-1} each at sowing & 30 DAS	96.9	111.5	126.3	144.2	152.1
Fertonic 60 kg ha^{-1}	65.6	80.9	95.3	112.4	126.5
Fertonic 120 kg ha^{-1}	66.4	81.9	95.4	112.6	126.1
Fertonic 180 kg ha^{-1}	66.6	82.1	95.6	112.9	126.4
		Ist Year		IInd Year	
		SEm±	CD (0.05)	SEm±	CD (0.05)
For two bioproducts at same fertilizer levels		4.4	12.4	4.6	13.1
For two fertilizer levels at same or different bioproducts		4.5	12.9	4.6	13.5

RDF (Recommended dose of fertilizer).

Table 4. Interaction effect of fertilizer levels and bioproducts on grain yield (kg ha^{-1}).

Bioproducts	**Fertilizer levels (NP kg ha^{-1})**					
	Control	25% RDF	50% RDF	75% RDF	100% RDF.(120+60)	
Ist Year						
Control	1015	2274	3516	4196	4732	
Agrispon 1 / ha^{-1} at sowing	2667	3469	4167	4793	4970	
Agrispon 1 / ha^{-1} each at sowing & 30 DAS	3166	4029	4692	5571	5892	
Fertonic 60 kg ha^{-1}	1031	2396	3540	4122	4761	
Fertonic 120 kg ha^{-1}	1024	2387	3530	4111	4748	
Fertonic 180 kg ha^{-1}	1027	2390	3534	4115	4753	
IInd Year						
Control	1196	2388	3631	4243	4825	
Agrispon 1 / ha^{-1} at sowing	2753	3662	4261	4844	5075	
Agrispon 1 / ha^{-1} each at sowing & 30 DAS	3295	4118	4791	5634	6006	
Fertonic 60 kg ha^{-1}	1143	2517	3627	4237	4820	
Fertonic 120 kg ha^{-1}	1151	2440	3638	4250	4834	
Fertonic 180 kg ha^{-1}	1154	2531	3644	4256	4839	
Pooled						
Control	1106	2331	3574	4220	4779	
Agrispon 1 / ha^{-1} at sowing	2710	3566	4214	4819	5023	
Agrispon 1 / ha^{-1} each at sowing & 30 DAS	3231	4074	4742	5603	5949	
Fertonic 60 kg ha^{-1}	1087	2457	3584	4180	4791	
Fertonic 120 kg ha^{-1}	1088	2414	3584	4181	4791	
Fertonic 180 kg ha^{-1}	1091	2461	3589	4186	4796	
	Ist Year		IInd Year		Pooled	
	SEm±	CD (0.05)	SEm±	CD (0.05)	SEm±	CD(0.05)
For two bioproducts at same fertilizer levels	153	434	166	470	158	451
For two fertilizer levels at same or different bioproducts	157	461	178	525	163	480

bolic activity viz. increased nitrogen metabolism due to tricontanol (Khan, 1994) higher rate of respiration due to IAA and GA (Filatova, 1987) and increased DNA and RNA content (Filatova and Malyagina, 1984). Agrispon contains growth hormones which are responsible for improvement in yield attributes of cotton as reported by (Anonymous, 1991) and (Tamak, 1997).

Yield

Application of fertilizer had significant effect on grain and straw yield of wheat. The grain yield increased significantly (at 5% level) with successive increase in fertilizer levels up to 120+60 Kg ha-^{1} NP (Table 2). Maximum grain yield of 5021 Kg ha^{-1} was recorded with recommended NP fertilizer based on pooled data. Expressed in percentage terms, the increase in grain yield was 192.1, 74.2, 29.4 and 10.8 due to 120+60 Kg ha-^{1} N and P over 0, 25, 50, and 75 percent recommended NP based on average value, respectively. Higher grain yield with 120+60 Kg ha^{-1} N and P was also reported by Tomer et al. (1995), and Prasad and Singh (1995). The percent increase in straw yield with 100% fertility level was 200.1, 200.3 ; 73.88, 74.8 ; 29.4, 29.6 and 12.0,11.6 over 0,25,50 and 75 percent fertility level during two respective years of study, respectively. These results are in conformity with the finding of Verma et al. (1994) in wheat crop.

The grain and straw yields were significantly higher with one and two spray of agrispon over control in both the years, the respective increase in grain yield was 27.0 and 47.4 percent over control on pooled data. Garzaro and Syltie (1994) and Tamak (1997), also reported improvement in the yield of various crops due to agrispon.

The interaction effect of fertilizer levels and bio products was also found significant at 5% level with respect to grain yield and effective tillers (Table 3 and 4). Significant higher number of effective tillers and grain yield was obtained at 75 percent fertility level under double spray of agrispon compare to 100 percent of fertility level with no bio product. This indicated higher efficiency of applied fertilizer under agrispon application. These finding corroborate with that of Tamak (1997). Improved grain yield of wheat due to cytokinin spray was also registered by Tomer et. al., (1995). Agrispon application enhanced fertilizer use efficiency. Fertilizer use efficiency increased with agrispon two sprays by 100% compared to the control (16.6 kg grain per kg nutrient).

CONCLUSIONS

On the basis of the results of the present study it may be concluded that application of agrispon @ 1 *l* ha^{-1} each at sowing and at 30 DAS improved the yield and yield attributes over its single application at sowing and control. Agrispon application interacted with fertility levels. Results indicated that 100% RDF was at par with 75% RDF along with agrispon two sprays. At last it can be concluded that 25% RDF can be saved with the application of agrispon @ 1 *l* ha^{-1} each at sowing and at 30 DAS.

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