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Effect of balance dose of fertilizers and irrigation on yield and yield component of wheat cultivar

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Abstract
The study has revealed that there is a sufficient potential increasing wheat production in Madhya Pradesh by provides quality seeds of improved variety, balance dose of fertilizers and awareness of irrigation schedules of wheat crop. Under demonstration is a most suitable method for assessing the performance of improved verities of wheat cultivar GW-322, GW-273 and MP-1142 respectively with the existing cultivars LOK-1 and Sujata under different irrigation levels. The results of demonstrations shows a greater impact on farmers face due to significant increase average in crop yield 47.1, 60.0, 52.6 and 68.4% respectively over local check. Which results in not only adopting these varieties in large scale but also some of the farmers have started producing seeds of these improved varieties and maximum yield was found of water loving and fertilizers responsive variety of wheat viz GW-322, GW-273 and MP1142 (57.8, 55.0 and 52.1 q/ha) respectively under four irrigation at all definable growth stages as compared to less responsible/frequency of irrigation of existing variety of wheat LOK-1 and Sujata (46.2 and 34.0 q/ha). And highest B:C ratio was obtained in wheat cultivar GW-322 (1:2.7) followed by GW-273 and MP-1142 under demonstration as compared to traditional variety of wheat Lok-1 and Sujata (1:2.2 and 1:2.1).

Keywords: No. of tillers, Percentage of effective tillers, yield and B:C ratio

Introduction

Wheat (*Triticum aestivum* L) is one of the main cereals crops, cultivated to meet great demands of the population for human feeding. It is the most important staple food in India. Rapid increase in wheat consumption outpaced domestic production due to population growth. The area of wheat in this country (29.25 m.ha) an account of production and productivity (85.93 m.tonnes and 2938 kg/ha, 2010-11 department of Agriculture and cooperation) is very quit low against the variety potential of wheat crop 4500-5500 kg/ha. Over all Agriculture production from wheat has tended to increase increscent years, but even this is not enough to keep up with population growth and positive outcome. Similar to defectively situation was noted in study area of Sehore District of Madhya Pradesh in terms of productivity (2000 kg/ha) as compared to national productivity. There are numerous regions was found for low productivity of wheat crop i.e. seed replacement rate is very poor, Imbalance use of fertilizers (50 kg/ha) and improper management of irrigation water due to lack of awareness to irrigation scheduling and other input like improved seeds and balance dose of fertilizers of wheat crop. Therefore, most of the farmers are supplying irrigation on availability of water neither is necessity of crop. Under such circumstances Fertilizer Association of India (New Delhi) has decide to conduct FLD on 50 farmer's field in this districts against the problems by the active participation of IFFCO with technical support of KVK. Because much extensive productive technology is now available this can boost wheat production. But any viable and adoptive technology has not reached to growers accorded by Singh *et.al* 2004 [21]. In such situation KVK develop a package for enhancing the productivity of wheat crop through introduction of improved varieties, balance dose of fertilizers and supply of water as per schedule of wheat crop. To reduce the yield gap between farmers practices and front line demonstration and shows the potential to increase the yield further. (Rahim *et al*., 2007, Wajid *et al*. 2002) [17, 24] reported that wheat crop produced highest grain yield by applying irrigation at all definable growth stages. Because adequate supply of irrigation water and fertilizers main factors affecting directly the growth and productivity of wheat plant. Water supply as per schedule is limiting factors for crop production it is desirable to obtain higher grain yield. Grain yield was affected by both the magnitude of water deficit and stage growth subjected to deficit. Schneider and Howell 1997 and Awad *et al*. 2000 reported that increase irrigation of soil water amounts from zero to 100 % significantly increased grain yield and its components. Hence an experiment was conducted to study growth, yield, B: C ratio and fertilizer use efficiency of wheat cultivar under balance dose of fertilizers and different irrigation scheduling.

Materials and Methods

Preliminary survey of farmers field for diagnose to problems of low productivity of wheat crop through discussion and group meeting. After surveyed was found problems low yield of wheat crop due to lack of awareness to improved technology and variety. A field experiment was conducted on five farmers fields of 10 villages for create awareness to improved technology, Variety and irrigation scheduling. Under demonstrations have one acre area with half acre for recommended practices and half acre farmers' practice. Collected soil sample for analysis of individual demonstration plot to work out nutrient requirement. And applied fertilizer on the basis of soil test value in half acre area of recommended practices. The all selected village is characterized medium to deep black soil which had low available nitrogen (250-280 kg N/ha), medium available phosphorus (12-20 kg P_2O_5/ha) and medium to high available potash (196-313 kg K_2O/ha) and soil p^H 6.8 to 7.8. The front line demonstration was laid out RBD design with observation of three replication. The study have indicated that the replacement of existing variety, imbalance use of fertilizer and irrigation management as per availability of water by improved variety GW-322, GW-273 and MP-1142, use of balance dose of fertilizers as per soil test value and irrigation management as per schedule of wheat crop. Application of complex fertilizers (N:P:K 10:26:26) @ 100 kg Plus urea @ 80 kg and Zinc sulphate 5 kg /acre and seed treated with Azotobactore and PSB @ 5 g /kg seeds). Full dose of complex fertilizers applied in field at the time of sowing. And remain dose of nitrogen through urea broad cast in wheat crop as two equal split applications at standing crop. Data were collected from both the demonstration and farmers practices with the help of personal contact and observations on yield and yield component was also recorded at the physiological maturity and threshing time. The on farm primary data was analyzed by percentage return to fertilizers in term of yield, Fertilizers use efficiency on economically and interaction impact of grain yield was calculated according to (Baligar *et.al* 2001 and Singh *et al.* 2007) [4, 22]. Harvest index (HI) is the ratio of grain yield to biological yield, which a measure of the efficiency of the plant when accumulating assimilates in the organs of economic significance (Donald 1968) [9].

Results and Discussion

Levels of use and gap in adoption of improved varieties of wheat with balance dose of fertilizers.

Farmers are generally use local varieties due to quality seed of improved varieties are not easily available and lack of awareness to their characters (Table-1). Very few farmers were able to arrange improved variety of seed. And they followed broadcast method of sowing against the recommended line sowing with seed cum fertidril. Therefore, they applied higher seed rate than the recommendation. And use of imbalance (lower) dose of fertilizer was applied against the recommended dose of fertilizers. Further full gap was observed in case of improved varieties, seed treatment, irrigation as per schedule and weed management of wheat crop.

Table 1: Level of use and gap in adoption of improved varieties of wheat with balance dose of fertilizers

Crop Operations	Recommended technologies	Existing technologies	Gap*
Variety	MP-1142.GW-273 and GW-322	Sujata, C-306 and Lok-1	Full gap
Land preparation	One cultivator ploughing and 3 ploughings	One cultivator ploughing and 3 ploughings	Nil
Seed rate	@ 100 Kg/ha (MP-1142.GW-273 and GW-322with line sowing)	@ 140-50 Kg/ha (broadcast or withoutline sowing)	Use of higher seed rate and avoid line sowing
Seed treated	@ 2 g Carbendazim with @1 g Thaiaram/kg seed	No use of fungicides for seed treatment	Full gap
Fertiliser	100:60:40 Kg/ha NPK with dual inoculation of Azotobactore and PSB@ 10g/ Kg seed	95 Kg/ha NPK without inoculation of culture	105 Kg/ha NPK, and No inoculation of culture
Weeding	Weed control through chemicali.e 2,4-D and sulfosulfuron	No weed control	Chemical weeding is not done (Full Gap)
Irrigation	Applying irrigation at all definable growth stages i.e. Crown root initiation, maximum tillering, boot stage and milking stage	Applying irrigation based on availability neither is necessity as per definable growth stages	Full gap

Growth and yield parameter

Among the five varieties evaluated maximum plant height (125 cm) was recorded in exiting variety of wheat cultivar Sujata (Table -2), differing significantly from rest of the tested varieties. Number of tillers/plant and percentage of effective tillers, were significantly higher in the wheat cultivar GW-322 (8.0/plant and 87.5 percent) respectively fallowed by GW-272 (8 and 87%) with the exiting variety of wheat Sujata & Lok-1, while the lowest number of tillers/plant and percentage of effective tillers was recorded in wheat cultivar Sujata (7.0/plant and 76 %). Further more number of tillers/unit area ($1m^2$), ear length and their width recorded in different varieties differed significantly except GW-273 and significantly higher harvest index was recorded in wheat cultivar Sujata and Lok-1. Earlier studies in wheat cultivar indicated that higher grain yield and net return were found to be associated with more number of effective tillers, ear length, ear width and test weight.

Table 2: Permormance of wheat varieties and their comparatively study in similar situation.

Varieties	Plant height (cm)	No. of tillers/plant	No. of effective tillers	Percentage of effective tillers	Total no. of tillers/m2	Ear length (cm)	Ear width(cm)	No. grains/ear	Test wt (g)	Grain yield g/m2	Straw yield/m2	Grain Yield q/ha	Straw yield q/ha	Grain straw ratio
MP-1142	87.0	7.5	6.5	86	322	11.3	1.4	40.0	36	411.8	547.7	41.8	54.7	1.3
GW-272	90	8.0	7.0	87	352	12.0	1.6	42	37	478.6	636.5	47.8	63.6	1.3
GW-322	87.5	8.0	7.0	87.5	352	11.0	1.6	43	36.5	483.4	642.9	48.3	64.3	1.3
Sujata	125	6.5	5.0	76	325	7.6	1.4	34.6	39	337.4	597.2	33.7	59.7	1.8
Lok-1	90.6	7.0	7.0	78	343	7.9	1.4	41.6	37	414.8	580.7	41.5	58.7	1.4

Grain and Straw yield

The pooled mean analysis of wheat varieties for grain yield indicated that the overall performance of GW-322 was significantly better with higher yield (48.3 q/ha) over the existing variety Sujata (33.7 q/ha) with an additional yield of 14.6 q/ha and 30.2 % increase. The straw yield of the variety was significantly lower in wheat cultivar MP-1142 (54.7 q/ha) than GW-322 (64.3 q/ha) indicated that the translocation of photosynthates was more towards economic parts. Tunio *et.al.* (2002) [23] also observed that variety with more productive tillers/plant, number of grains /ear, ear length and their width recorded higher yield. The enhancement in yield of different wheat cultivar 19.4 to 30.2 percentages was recorded in recommended practices over farmer's practices. Due to balance dose of fertilizer with improved variety, because its dose play vital role in photosynthesis and proper uptake of nutrients as per crop demand. This ultimately resulted in increase photosynthetic activity better growth owing to enzyme activation. Consequently better expression of all these yield and yield attributes resulted increased grain and straw yield of wheat these findings are in agreement with those of Dubey and Sharma 1996 [10], Manna *et.al* 2003 [13], Aulakh and Malhi 2005 [3] and Behera *et.al* 2007 [5].

Grain Straw ratio

The maximum grain and straw ratio was recorded in existing varieties of wheat Sujata as compared to bread wheat cultivar GW-322, GW-273 etc. While maximum dry matter production was recorded in bread wheat cultivar GW-322 fallowed by GW-273 as compared to existing variety of Sujata and Lok-1. Because high yielding semi dwarf varieties is basically known to more water and fertilizers responsible. Therefore, appropriate supply of fertilizers with efficient water supply during all growth stage increases the leaf area of the crop enable it to intercept most of the incoming radiation through increasing leaf production and expansion rate that effect of increase interception of photosynthetically active radiation (PAR) by photosynthetic organ. And conversion of the intercepted radiation in to dry matter and more portioning of that dry matter into economic grain yield as expressed harvest index and consequently the increase maximum dry matter production (Pal *et.al* 2001 and Moragues *et.al* 2006) [16]. Insufficient availability of NPK to wheat plant results in low dry matter production and significantly reduced profit compared to properly fertilize with irrigated crop.

Effect of irrigation management on varietal performance

The crop was received irrigation based on availability neither is necessity. Its due to yield is more fluctuate between water loving variety and limited irrigated variety due to less response of yield/frequency of irrigation. While farmers are supply of water based on availability neither is necessity due to lack of awareness of irrigation scheduling of wheat crop. In such situation observation was recorded at harvesting stage i.e. Yield and yield attributes, cost benefit ratio under different irrigation schedule i.e. Crown root initiation (CRI), maximum tillering, boot stage and milking stage. Maximum yield and yield attributes was noted in wheat cultivar i.e. GW-322, No. of tillers/m,^{2} Percentage of effective tillers, No. of grains/ears, Test weight, grain yield q/ha (8.0,96.0,43.5,37.8 and 57.8) respectively fallowed by GW-273 (8.0,95, 352,41.8, 37.4 and 55.0) as compared to existing variety LOK-1 and Sujata (7.0, 80.0,35037.4 36.6, 46.2 and 6.0, 80, 300, 37.8,34.0) respectively (Table -3). And slightly low to similarly yield was found in all cultivar GW-322,GW-273,MP-1142,LOK-1 and Sujata (57.0,53.2, 52.1,45.8 and 32.8 q/ha) respectively of wheat crop with three irrigation irrespective of time of application as compared to two irrigation GW-322,GW-273,MP-1142, LOK-1 and Sujata (50, 48.9,45.6,38.2 and 31.2 q/ha) Pal. *et.al.* 1996 [15], Pal *et.al* 2001 [16] also observed yield reduction in wheat with irrigation compared with the crop raised with four irrigation. Wheat receiving three irrigations at maximum tillering, booting and milk stage gave similar to lower grain and straw yield compared with four irrigation. Maximum dry matter accumulation though out the crop growth period was recorded in the crop received four irrigation at (Crown root initiation (CRI), maximum tillering, boot stage and milking stage) with balance dose of fertilizers. Unavailability of moisture at any critical growth stage significantly reduction of dry matter accumulation its resulted very poor yield. Water stress not only affects the morphology but also severely affects the metabolism of the plant. Therefore reduce the number of grains formed per spike and kernel weight which ultimately reduced yield accorded by (Jamal *et.al.* 1996, Asharf 1998, Denciel 2000 and Gupta *et.al.* 2002) [12, 7, 11].

Economic Impact

The cost of cultivation in demonstrations was comparatively higher (Rs 22375) as compared to farmer's practice (Rs 20500) on account of additional input provided in the demonstration. The gross returns (Rs. 56870 to 62260) and net returns (Rs 35370 to 40760) were derived from demonstrations as compared to farmer's practices (Rs 43810 to 45650) and net returns (Rs. 24310 to 26150). On average basis, the increase in net returns from adaptation of improved production module was 31.56 per cent over farmer's practice (Table 2). The benefit cost ratio was accordingly reflected to demonstrations (1:2.5 to 1:2.7) and farmer's practice (1:2.1 to 1:2.2).

Fertilizer use efficiency and percentage return to fertilizers.

Fertilizers use efficiency based on economically was found over 278 % in wheat cultivar GW-322 fallowed by GW-273 and MP-1142 (254 %) as compared to exiting variety 228 and 219 % Lok-1 and Sujata (Table-3). Because fertilizer use efficiency in crop plant is an important approach to evaluate the applied fertilizers and their role in improving in crop yield (Singh and Agrwal 2005) [16]. And maximum percentage return to fertilizers in wheat cultivar GW322 was found 16.8 % fallowed by GW-273 and MP-1142 (11.9 and 11.6 %) respectively as compared to farmers traditional variety of Wheat Lok-1 and Sujata (8.3 and 7.7%) when use of balance dose of fertilizers, due to proper availability of nutrient as per crop demand leads to improvement in grain yield and consequently the higher nutrient use efficiency similar report was found (Baligar et.al 2001, Singh and Agrwal 2005 and Singh *et.al* 2007) [4, 21, 22].

Table 3: Effect of irrigation management on varietal performance at different stages

Variety	No of irrigation	No of Tillers/ plant	No. of effective tiller/plant	Percentage of effective tillers	Total No. of tillers/m^2	No. of grains/ear	Test wt.(g)	Grain yield (g/m^2)	Grain yield(q/ha)
MP-1142	CRI	5.0	4.0	80	220	34	34.6	258.8	25.88
	MT	8.0	7.5	93.7	330	38	36.4	456.4	45.6
	BS	8.0	7.5	93.7	330	42	37.2	515.2	51.6
	MS	8.0	7.5	93.7	330	42	37.6	521.1	52.1
GW-322	CRI	5.1	4.0	78.4	224	31	34.7	241.3	24.1
	MT	8.0	7.6	95	352	39	36.8	505.1	50.0
	BS	8.0	7.7	96	352	43.5	37.3	571.1	57.0
	MS	8.0	7.7	96	352	43.5	37.8	57.8	57.8
Gw-273	CRI	5.0	4.1	82	220	31	34.0	231.8	23.2
	MT	8.0	7.4	92.5	352	38.5	36.1	489.2	48.9
	BS	8.0	7.5	93.7	352	40.6	37.1	530.2	53.2
	MS	8.0	7.6	95	352	41.8	37.4	550.2	55
Sujata	CRI	4.0	3.0	75	220	26	36.1	206.8	20.6
	MT	6.0	4.8	80	300	28	37.1	311.6	31.2
	BS	6.0	4.8	80	300	29	37.8	328.9	32.8
	MS	6.0	4.8	80	300	30	37.8	340.2	34.0
LOK-1	CRI	4.4	3.4	77.2	220	30.4	33.4	223.3	22.0
	MT	7.0	5.6	80	350	32.3	33.8	282.2	38.2
	BS	7.0	5.6	80	350	37.0	35.4	458.4	45.8
	MS	7.0	5.6	80	350	37.4	36.6	462.2	46.2

Crown root initiation (CRI), maximum tillering, boot stage and milking stage

Table 4: Effect of varietal performance on economic value and Fertilizers use efficiency

Variety	Yield (q/ha)	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio	Percentage return to fertilizers	FUE on economically	Interaction impact on grain yield
MP-1142	51.7	22375	56870	35370	1:2.5	11.6	254	34.8
GW-273	52.6	22375	56870	36360	1:2.5	11.9	254	35.9
GW-322	56.6	22375	62260	49760	1:2.7	16.8	278	40.5
Sujata	33.7	20000	43810	24310	1:2.1	7.7	219	-
Lok-1	41.5	20000	45650	26150	1:2.2	8.3	228	18.7

B: C ratio = Benefit cost ratio, FUE=Fertilizers use efficiency

Conclusion and recommendation

All demonstrated varieties and existing varieties are good performing under four irrigation as schedule of wheat. But very poor increase grain yield/frequency of irrigation of existing variety of wheat Sujata as compared to water loving varieties viz GW-322, GW-273 and M.P 1142. Because existing varieties is slightly drought tolerant it is due to less response of each frequency of irrigation with balance dose of fertilizers and water loving variety have more response of each frequency of irrigation along with recommended dose of fertilizers. Therefore, the most of the farmers should aware to irrigation scheduling of wheat crop based on availability water responsive variety. While, most of the farmers' of these districts unaware of irrigation schedule of wheat crop. In such situation maximum farmers gave two to four irrigation based on availability of water neither is necessity of water requirement it is due to wastage of irrigation water. Under such circumstances provide information to all wheat grower, that have more irrigation capacity they can select more water and fertilizers responsive variety i.e. GW-322 GW-273 and MP-1142. And they farmer have less irrigation capacity they can select slightly drought tolerant variety i.e. Sujata, JW-17, Amrita, Harsheeta and C-306, about exploit to yield potential of variety and water.

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