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THE SYSTEM OF WHEAT INTENSIFICATION IN COMPARISON WITH CONVENTION METHOD OF WHEAT LINE SOWING TO INCREASE WHEAT YIELD WITH LOW INPUT COST

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Abstract

A field experiment was conducted during the *rabi* seasons of 2013-14, 2014-15 and 2015-16 with 30 farmers of village tansramal, saroth, rajegaon, mohkhed of block Mohkhed at district Chhindwara, Madhyapradesh. System of Wheat Intensification (SWI) with conventional method of wheat sowing was compared under the yield aspects. Seed treatment comprises of treated and untreated seeds were allocted in SWI (25×25cm) and conventional line (22.5cm). Treated seed gave relatively higher effective tillers, number of grains and 1000 grain weight of wheat as compared to untreated seed. Irrigation water productivity was highest in SWI method as compared to conventional line sowing in 2013-14, 2014-15 and 2015-16 respectively. The result of experiments suggests that the adoption of SWI method by maintaining appropriate plant spacing and nutrient management could greatly enhance wheat production particularly in all regions of Madhya Pradesh. The results of experiments represent that SWI methods are superior than conventional line sowing of wheat with improved recommended practices and far superior to usual farmers practice. The total amount of irrigation water used in conventional line sowing of wheat was 60 mm more than SWI method.

Key words: SWI, Line sowing and seed inculcation.

Introduction

Wheat *(Triticum aestivum L.)* is the most important cereal food crop ranking first in India both in area and production of the grain crops, And second largest production of world after China. It can be grown from below sea level to 5000 m altitude and in areas where rainfall ranges between 300-1130 mm. wheat contributes more calories and more protein to the world's diet than any other food crop. In India major wheat area is under subtropical region. The cool and sunny winters are very conductive for growth of wheat crop. Wheat contributes more towards public distribution system (PDS) and has become backbone of country's food security, (Prasad and Gupta. 2012). In India during 2013-14 area under wheat cultivation was 31.19 million hectare, production 95.91 million tones and yield 3075 kg per hectare, now comes in condition with MP area was 5.79 million hectare, which was 18.57% of total area of India, production was 13.93 million tones, yield was 2405 kg per hectare and this contributed 14.52% of total yield of India (source-Directorate of Economics and Statistics, Dept. of Agriculture and Cooperation India). The system of wheat intensification (SWI) method has a great potential to increase wheat productivity and creates a very good growing condition through modified soil, water, sowing method, plant and nutrient management. SWI and some modified SWI interventions may give 54% more yield than available best conventional sowing practices (Uphoff *et al.*, 2011, Adhikari, 2012) and showed a better economic return (Raol, 2012). System of wheat intensification is based on the principles of system of rice intensification (SRI), is a new wheat cultivation technique which demands to maintain plant to plant and row to row distance at 25 cm., this kind of sowing with proper plant

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density allows for sufficient aeration, moisture, sunlight and nutrient availability leading to proper root development system from the early stage of crop growth till harvesting. SWI is the system of modified agronomic practices such as lower seed rate, seed treatment, sowing of seeds at proper spacing, control of water in crop field, weeding or hoeing inputs which result in higher ratio of tillers to mother seedlings, increased number of effective tillers per hill, enhance panicle length and bolder grains and finally enhanced yield of wheat. In the conventional system, farmers use about 100-140 kg/ha of seed but in the SWI method seed requirement is only 5%-7.5% of this amount (Styger and Ibrahim, 2009). A suitable combination of organic and inorganic sources of nutrient is necessary for a suitable agriculture (Reganold *et al.* 1990). SWI is one of the promising technologies to increase productivity which ultimately contributes to the household level of food security of marginal farmers. This technology has high potentiality to provide high yield per drop of water and per kg of agricultural inputs. SWI method was initiated in India by some community workers on fields of small and marginal farmers in 2006 and their encouraging results paved the path of systematic research among the farmers, (Anil Kumar *et al.* 2015). SWI has been successfully promoted by many agencies like Pradhan (2014), an NGO in MP, and agriculture technology management agency (ATMA) of Govt. of India, Peoples Science Institute (PSI) another NGO in Uttarakhand (2015) in India and USAID in Mali (2012). SWI has been tested as innovative approach to increase productivity and being practiced in MP at Chhindwara, SWI is evolving and being tested in many places of MP. The promotion of SWI has shown very good results in combining hunger among marginalized and small farmers. These technologies are supposed to reduce the dependency of the farmers on multi-national companies for seeds, fertilizers or for their livelihoods, (Rout *et al.* 2010). The main objective of this extension work is to compare the yield from traditional practice of sowing with that of SWI, so that it will be technically effective and feasible, economically viable, socially acceptable and environmentally sound for the wheat production. Results has sown that grain yield of wheat is increased by double of previous yield at its maximum, with adoption of this technology. Similar results were obtained from the experiment trials conducted by KVK of Chhindwara district of MP.

Principals of the system of wheat intensification (SWI)

The prevalent system of wheat cultivation requires more chemical fertilizers and nearly 100-140 kg of seed per hectare. SWI uses only 25-30 kg of improved seeds in one hectare. 25 cm between row to row and plant to plant, use of organic manure and organic seed treatment ensures higher yield. Sufficient spacing between the plants and sowing of 2 germinated seeds at one point facilitates desired moisture, aeration, nutrition and light to the crop roots. This helps faster growth of plants. Only 2-3 times irrigation and weeding through cycle hand wheel hoe save time and expenses on labour. SWI is primarily based on these two principles of crop production,

1. Principle of root development

2. Principle of intensive care

Materials and Methods

Few field experiments was conducted during the *rabi* season of 2013-14, 2014-15 and 2015-16 with 30 farmers of village tansramal, saroth, rajegaon, mohkhed of block Mohkhed at district Chhindwara, Madhya Pradesh. The experimental site is located at 22.20° N latitude and 79.26° E longitudes at an elevation of 475 meters above the mean sea level. The soil belongs to medium to light black with annual average rainfall of 750-1150mm under the Agro Ecological Situations II of Chhindwara district. The soil was low in organic carbon and available potassium, medium in available phosphorus. The experiments were conducted with 2 plots following two treatments, each had an area of 1 acre as treated plot and 1 acre as conventional line sowing plot. Spacing of SWI p/p and r/r was 25 cm while in conventional line sowing r/r was 22.5cm and p/p was not maintained because of sown with seed drill. Seed were treated using luke warm water followed by dipping the 10 kg of seed in 20 litre of luke warm water to remove lighter seeds and impurities. After pouring the seed were stirred and floating seed and impurities were removed by sieves or by hands. Then 1 liter of cow (indigenous) urine, 250 gm of jaggery and 500gm of vermicompost were added with 2 liter of water and thoroughly mixed with seed containing water. The mixture was left for 8-10 hours or overnight and then filtered. The seeds were swollen. The swollen filtered seeds were treated with Carbendazim 2gm/kg seed and kept in wet jute bag for 10-12 hours. The seeds were dried in shade for half an hour just before sowing to facilitates easy sowing of seeds. Field was prepared with one disking followed by cultivator twice. Planking was done after cultivator. After final cultivator SWI method seeds were sown at square marked distance as per treatment by marking with rope. One 25 cm marked rope was fixed in the width of field and 8-10 of marked rope were moved across the length of field and treated 2 seeds were sown per hill. Wherever seeds had not germinated, gap should be filled with germinated seeds

within 10 days of sowing. Conventional wheat sowing was done in line at 22.5cm by tractor drawn seed drill. Irrigation might be made in two ways one just after sowing of SWI seed or one might be prior to sowing. Delay in irrigation may cause death of treated seed. Irrigated normal sown and medium height wheat variety GW- 322 were used for experiments in all 3 years. GW-322 variety of wheat is recommended for cultivation in MP, timely sown, irrigated, early maturing (125-135 days), 41-45 q/ha. Yield, 90-100 cm plant height, 10-11% protein content, good chapati making quality and having resistant with stem as well as leaf rust.

4-5 irrigations were applied in SWI treatments scheduled as first irrigation at 15-20 DAS followed by 35-40, 55-60, 75-80 and 100-105 DAS during all 3 years by sprinkler irrigation. Winter monsoon was supported the crop plants. During the flowering and grain filling stage there should be sufficient moisture in the SWI field. In conventional line sowing, 6cm depth of water was maintained for all irrigations starting from crown root initiation stage (CRI) to the physiological maturity of crop. However in SWI, 4 cm water was applied and alternate wetting and drying conditions were maintained throughout the cropping season to keep the soil moist but unsaturated. After the first irrigation first hoeing and weeding (25-30 DAS) was done by using cycle hand wheel hoe followed by second in 55-60 DAS, to loosen the soil and to make the field free from weeds. The loosening of soil results in better aeration for the root zone and increases the root length by letting the crop plants to take more moisture and nutrient from soil. This helps in bringing forth more tillers in the plant with more vigour. Tillers were counted at 25 DAS there 20-22 tillers and 50 DAS there were 47-58 tillers. Fertilizers were applied on the basis of soil testing in two split doses. Fertilizers were applied at the following rates in one acre of field -

Table 1: Fertilizer requirement (kg ha^{-1}) for irrigated timely sown wheat.

Production condition	Nitrogen (N)	Phosphorous (P_2O_5)	Potash (K_2O)	Zinc sulphate
Irrigated timely sown	100	60	40	10

At maturity the experimental and conventional line sowing plots were harvested by sickles and bundled separately. The bundles were dried upto 8-10% moisture content to open the sunshine, threshed, and then grains were cleaned. The grain and straw yields were taken plot wise separately in 5 × 5 m and converted into per hectare. There were no attack of any insect pest and diseases in all 3 years of experiments.

Results and Discussion

Higher effective tillers grains per spike and 1000 grain weight of wheat were observed in experimental plot with conventional plots. In SWI number of tillers per plant is found 4-5 times more than conventional method as well as higher test weight were recorded respectively. This may be due to wider spacing and proper aeration under SWI. Straw yield obtained in the SWI was also significantly higher as shown in table 2.

Chopra and sen (2013) has also reported grain yield of wheat similarly in comparison with broadcast method of sowing. Abraham *et al.* (2014) reported an increase of 18-67% grain and 9-27% straw yield of wheat at farmers field in SWI as compare to broadcast method. The results of experiments represent that SWI methods are superior than conventional line sowing of wheat with improved recommended practices and far superior to usual farmers practice. The total amount of irrigation water used in conventional line sowing of wheat was 60mm more than SWI method. It was due to higher irrigation depth. Uphoff (2012) in his booklet supplement has summarized the results from wheat sown under SWI in farmers field reported that a 30% water saving is observed in SWI in comparison with conventional method of sowing.

Summary and conclusion

The experiment shows that wheat crop responds

Table 2 : Yield character of wheat cv. GW-322 sown in SWI and conventional method

S. No.	Parameters (average of 10 plants)	2013-14		2014-15		2015-16	
		Conventional	SWI	Conventional	SWI	Conventional	SWI
1.	Number of Tillers	6	27	5	25	7	32
2.	Grains/Spike	24.6	49.8	22.4	46.8	50.3	73.5
3.	Number of spikes/ m^2	315	426	307	403	407	462
4.	1000 grain wt (gm)	53	68	50	61	54	76
5.	Grain yield q/ha	31.9	57.3	30.6	54.8	32.8	61.3
6.	Straw yield q/ha	5.4	7.4	5.0	6.9	5.9	8.12

positively to seed priming and line sowing. The variety is most suitable for climatic conditions of Chhindwara. Grain yield is significantly increased by treating the seeds organically before sowing them in the field. Reduced plant population is crucial for increasing the number of tillers per plant, plant height, spike length and size of grains resulting in higher grain and biomass yield. The following points were observed by experiments in comparison with conventional method-

- No weeds
- More insect pest and disease resistant
- Double yields
- High quality grains
- Lower cost of cultivation
- Improve soil fertility

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