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System of wheat intensification (SWI): An innovative approach for increasing yield of wheat in Auraiya district of Uttar Pradesh

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Abstract
SWI transplantation is very effective, so it is latest method of Wheat cultivation that will help in feeding the increasing population of India by increased yield with low cost. The study was conducted in 15 villages of Bhagyanagar block of Auraiya district for the first time by Krishi Vigyan Kendra, Auraiya (U.P.) under Pilot Project for Promotion of System of Wheat Intensification under FTTF in Auraiya district of U.P. funded by NABARD, Lucknow (U.P.). 10 farmers from each selected village were selected to cultivate wheat with the help of SWI method. Thus total 150 farmers were selected for the study. The demonstration was conducted in 36 ha. Land in 2012-2014. This experiment compared the performance of wheat under System of Wheat Intensification (SWI) and conventional method. The cost of cultivation was found more i.e. Rs. 2163/ha in SWI technique (Rs. 34763) as compare to conventional method (Rs.32600). In Rabi 2012 and 14 the Average wheat yield of SWI was 46.12 q/ha. It was about 22.45% higher than conventional method (37.6 q/ha) 2013-14. It also saved seed requirement about 75-80% seed saving Only 20-25 kg/ha).

Keywords: Intensification, tillers. panicles /hill, seed treatment, DAS, conventional

Introduction
Wheat (*Triticum aestivum* L.) is the most extensively grown cereal crop in the world, Wheat stands second in grain production in the world and most widely cultivated food. Wheat is one of the major crop in U.P. as well as in India. Wheat has ranks IInd in production in the world. India has been second largest producer of wheat after china. Globally, wheat is grown in 122 countries over an area of 222.6 million hectare and producing nearly 716.1 million tonnes during 2013-14.

In India it produces about 95.91 million tonnes of wheat from an area of 31.2 million hectares with an average yield of 3.08 tonnes /ha (2013-14). Whereas Uttar Pradesh ranks first in terms of both area and production of wheat contributing about 34.42 percent of national production (30.24 million tonnes) having the area 99.56 million hectare is much lower as compared to Punjab and Haryana in 2014.

System of Wheat Intensification (SWI) method of wheat cultivation is one of the most effective methods which gives high production with low cost and without harming the environment. SWI is a new concept and goes with the SRI principle. The System of Wheat Intensification (SWI) was tested first time by Farmers in Goundam and Dire, Timbuktu, Mali in 2009. In 2008, some first trials with SWI were initiated, comparing transplanting of young wheat seedlings (with wide spacing, small but regular applications of water, increased organic matter, etc.) with direct-seeding and with controls (traditional broadcasting of seed to establish the crop.

It can reduce weeding time to one third and to one-half of the time needed for current weeding practice. Herbicide use is effective with SWI, but farmers are inventing or modifying tools that reduce the labour time required for weeding. Thus, SWI is a methodology aimed at increasing the yield of wheat, where all agronomic principles are put into practices to provide high wheat yield per drop of water and per kg of agricultural inputs like fertilizer, seed etc.

(Dhar *et al*., 2014) [1]. This methodology of wheat cultivation can increase yield by two to three times through some improvements in crop management factors. This technology was already evaluated and demonstrated in some countries in the world including India.

Why SWI is Needed?

The SWI is an adaptation of techniques used in the SRI. SRI has been successfully practiced in 35 countries worldwide. In terms of agricultural productivity, the sustainability of the farming system is an important issue. More than 10 million hectares under rice-wheat cropping system in North India is one of the most intensively cultivated areas in the world, which is possible only through the use of more intensive inputs like seeds, chemical fertilizers, herbicides, plant protection chemicals etc. Imbalanced use of external inputs particularly agrochemicals (fertilizer, fungicides, pesticides, herbicides) might cause deleterious effect on the soil and environment, as well as on the system productivity.

Principles of SWI

SWI is mainly based on the following two principles of crop production:

Principle of Root Development: Healthy root development is an important factor for healthy growth of a plant. Conventionally, Wheat seeds are sown in a closer manner i.e., no specific space is maintained between the seeds leading to competition between the roots of the plants for nutrients, water and sunlight. The weed population will be higher because of closer spacing, thereby increasing the number of competitors for the resources (Kaur, 2012) [5]. Root growth inhibition is promoted by crowding leading to poor resistance for the weeds. SWI technology involves proper plant spacing, roots of the plants get proper space to spread out, better nourishment, better light, more oxygen and the soil quality is also improved by the period oftime leading to higher number of effective tillers, higher yields and better nutritive quality.

Principle of intensive Care: The plant growth is usually hampered by many biotic and abiotic factors, ajor factors include improper nutrients and water availability, poor water and nutrients quality, diseaseincidence, Insects/pests and weeds. Principle of intensive care does not support higher number of plantpopulation per unit area rather it holds up with proper space maintenance and close monitoring and careof the plants. This can be done by adopting Good Agricultural practices, time to time soil and water testing and close monitoring of the plants.

In this area, given the heat and wind of the winter season which cause desiccation in plants, direct extrapolation of SRI methods to wheat in this area, i.e., transplanting young seedlings, produced poor results than conventional practice. However, a direct-seeded version of SWI gave 13% higher yield, with30-40% less labour. The productivity of labour with this method (yield per hour of labour input) went up by75%, and 25-30% less water was required.

Agriculture scientists stated that SWI method helps in 45% cost of weeding 65-70% cost of seed. SWI transplantation is very effective, so it is latest method of Wheat cultivation that will help in feeding the increasing population of India by increased yield with low cost. SWI method of Wheat cultivation is such a method which increases farm yield with low cost and also saves environment. Keeping view in mind the study was planned with the objectives of to increase the yield of Wheat, To save water by less irrigation and to know the cost of cultivation.

Material and Methods

The present study was conducted in 15 villages of Bhagyanagar block of Auraiya district for the first time by Krishi Vigyan Kendra, Auraiya (U.P.) funded by NABARD. The village of Auriya district where wheat crop is mostly grown *viz*. Bahadurpur, Makhanpur, Aruchi Ka Purwa, Mudhi, Parwaha, Kutubpur & Haziyapur , Baruwa, Dharampur, Futatal, Ujitipur, Kajipur etc. were selected randomly for study.

Selection of farmers

10 farmers from each selected village were selected to cultivate wheat with the help of SWI method. Thus total 150 farmers were selected for the study. In all 150 number of farmers were selected proportionally from each category of farmers and classified into three categories i.e. marginal (below 1 ha), small (1-2 ha), medium (2-4 ha). The period of enquiry pertain to the agricultural year 2014-15.

Capacity building training to selected farmers

One day Capacity Building Training Programs were organized in each selected village for capacity building of 15 farmers of that village. During training program, knowledge of SWI method for wheat cultivation was departed to the farmers by the experts from Krishi Vigyan Kendra, Parwaha, Auraiya. One video shows were organized in all the selected 15 villages to depart the knowledge of SWI technique to the farmers. These video shows helped the farmers to gain knowledge of SWI methods.

Distribution of Input

- The marker was distributed to each farmer for sowing the wheat in equal distance of plant to plant and row to row i.e. 20 x 20 cm.
- Rs 50/- were provide to purchase Gur + basen to each farmer for healthy seed germination and increase the tillering for better grain production.
- A Wheel hoe was distributed to each cluster of 5 farmers for weed management under SWI technique for wheat cultivation, In this way 30 Wheel hoe were distributed to all selected 150 farmers.
- Pamphlet containing Knowledge about SWI Technique was distributed of the farmers. Farmers got the knowledge about SWI technique by studying the leaflets.

Package of Practices for SWI

- SWI is Similar to that of SRI technology, SWI also requires quality seeds as well as special agronomic management practices. Details of wheat cultivation with SWI technology as following:
- **Land preparation:** Prior to final land preparation (15-20 days ahead) 4.0 t FYM per ha of land should be applied. If the soil does not have appropriate moisture, irrigate before ploughing.
- **Seed selection and treatment:** Only healthy seed PBW 343 were selected which was commonly used by most of the farmers of the district. Always certified seed, purchased from a reliable source.
- **Seed treatment:** The following inputs are required: Improved seed (10 kg), 20 liters warm water (60 oC), Vermicompost (5 kg), Gur (4 kg), Cow urine (4 liters), and Bavistin (20 g).
- **Seed Treatment Process**: According to PRADAN (2012) [2] the following steps are to be taken sequentially.

1. Seed 10 kg s).

2. Take 20 liters of warm water (up to 60°C) in a vessel.
3. Put the seed material in the warm water.
4. Remove the floating seeds (chaffy in nature) from the warm water. Add 5 kg vermin-compost, 4 kg gur and 4 liters of cow urine, and keep the mixture for 8 hours.
5. Separate the seed mixture from the solution and then sieve it through a cotton cloth.
6. Add 20 g Bavistin to the seed mixture and keep this for 12 hours in a wet jute bag for germination and for subsequent sowing.

- **Sowing:** The sprouted seed used for sowing in the field by dibbling using two seeds per hill. Different row to row and plant to plant spacing 20 cm × 20 cm used depending on the moisture content. A motorized seed drill were used for sowing. Seeds will be sown at a depth of 2.5–3.0 cm using a dibbler or pegs. Wherever the seed failed to germinate or destroyed, the gaps were filled with germinated seeds within 10 days of sowing.
- **Irrigation:** Phase-wise irrigation management should be as follows.
- First irrigation was done 15 days after sowing (DAS) to trigger root initiation. Otherwise, unavailability of moisture in soil will prevent root initiation.
- Second irrigation was given at 25 DAS, results in emerging a greater number of tillers. Third irrigation was given at 35-40 DAS.
- Subsequent 4th irrigations was given at 60, 80 and 100 DAS, depending on soil and climatic conditions. During the flowering and grain-filling stage, appropriate moisture should be available in the soil.
- **Weed Management:** Hoeing is essential component of SWI since it ruins the weeds that compete with crop for space, light, water and nutrients. Weeding was done through wheel hoe to loosens the soils and effectively aerates the roots, allowing exploration of soil that leads to better water and nutrients absorption from deeper soil depth

For the analysis of the impact of the project, database of the every farmer were collected and maintained. Percentage yield increase and B:C ratio were calculated .

Results

The results of the present study as well as relevant discussion have been summarized under following heads:

Effect of SWI on Tillering

Maximum and minimum number of tillering in field counted in every demonstration of random basis. It was observed that out of 150 demonstrations, The maximum tillering were reported in 99 demonstration in the range of 25-30. Further in case of only 36 demo no. of tillering was reported in the range of 30-35 and only 15 demo had tillers in the range of 10-15. that depicts high number of tillers in all the demonstrations.

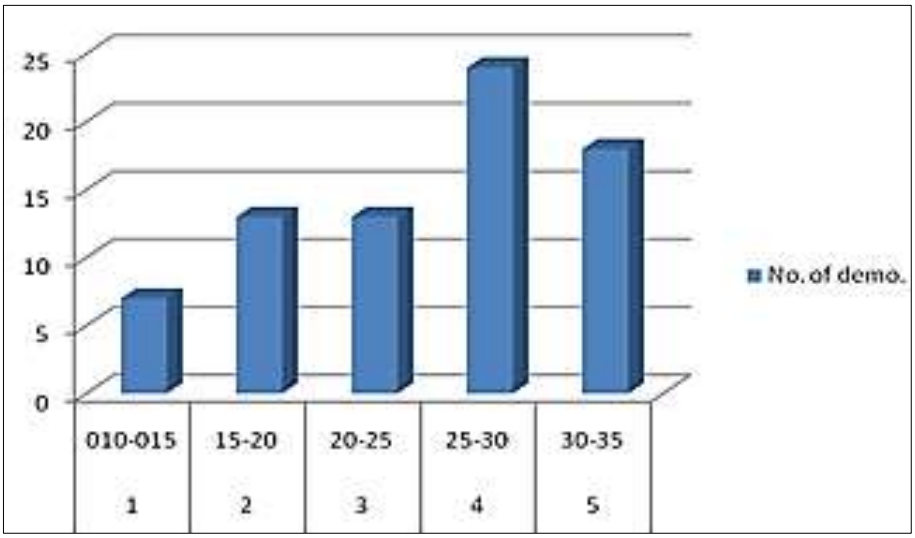

Fig 1: Impact of SWI on tillering

Capacity building training

Tiller Stage of Wheat Crop

Harvesting of Wheat Crop

Table 1: Comparison between traditional wheat cultivation and system of wheat intensification in Auraiya district:

Particulars	Traditional cultivation	SWI
Seed Variety	**PBW 343**	**PBW 343**
Seed rate	120-125 kg/ha	25-30 kg/ha
Seed treatment	Not done	Cow urine +Cow dung+ Gud +besan
Sowing	Broadcasting	Line sowing
Spacing	No spacing regulation	20 cm × 20 cm
Weeding/ wheel hoe	Not done	2-3 times
Length of panicle	12-13 cm	16-18 cm
No. of grains/panicle	23-52	65-115
No. of panicles/hill	Good stand 5-9	28-36
Yield q/ ha	37.6	46.12
Yield % increase	-	22.45

Table 1. depicts that in SWI technique the No. of grains/panicle was 2-3 times more than conventional method it may be due to proper spacing and weeding. The yield of wheat was also increased 22.45 percent as compared to conventional method Similar Study was reported by Rana, Lalita et all. and (2017) [3].

Table 2: Comparative cost of cultivation under conventional method of wheat cultivation and SWI

Particulars	Conventional (₹/ Ha)	SWI (₹/ Ha)
A) Operations		
Ploughing	5000	5000
Seed & seed treatment	5000	1000
Sowing	500	2500
Weeding and earthing	0	3350
Irrigation	4000	3813
FYM	3000	3000
Fertilizer (120:80;60 :: N:P:K kg/ha	3400	3750
Plant Protection	2000	2000
Harvesting and threshing	5,000	5,500
Thrashing	3500	3700
Winnowing and Packing	1200	1450
Total cost of Cultivation (Rs.)	32600	34763
B) Yield and Income		
Grain yield (q/ha)	37.6	46.12
Gross income @ 1400 per q	52640	64568
Straw yield (q/ha) Straw	50.76	65.5
Straw Income@150 per q	7614	9825
Total gross income (Rs.)	60254	74393
Net income (Rs)	27654	39630
B:C Ratio	1.84	2.14

Table clearly shows that cost of cultivation was found more i.e Rs. 2163 / ha in SWI technique as compare to conventional method. The production was recorded 46.12 q/ ha in SWI method whereas 37.6 q/ha in conventional method and Net income was also found more in SWI as compare to conventional method. Per quintal cost of production was found to be Rs. 1270.00 and productivity was 28.73 quintal per hectare reported by Ravindra Singh *et al.* (2018) [4].

The Overall impact of SWI Programm in Auraiya District
150 demonstrations were undertaken in 15 villages of Bhagyanagar block of Auraiya district for the year of Rabi 2012-13 and 2013-14. Total area covered under this demonstration programm were 36.0 ha. Overall productivity with comparison to conventional system and growth in crop yield is depicted and illustrated in fig as under.

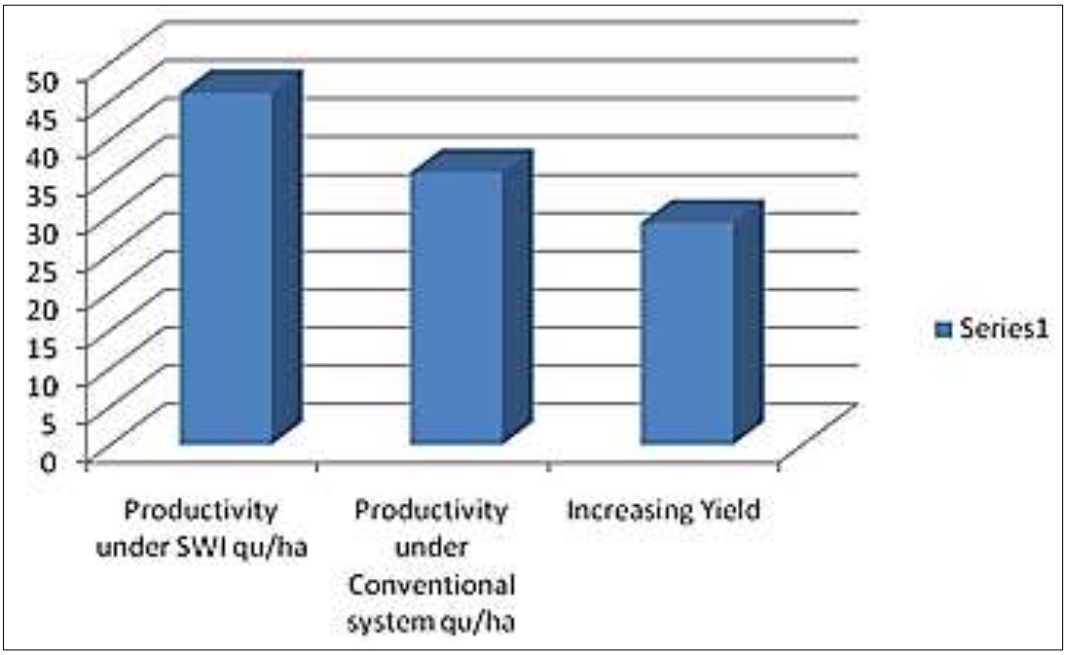

Fig 2: Impact on yield increasement

It was found that out the average production in conventional system was.37.6 q/ ha and average yield was recorded 46.12 q/ ha.in SWI technique Thus the yield increase 22.45 percent.

Advantages of SWI
1. More number of effective tillers.
2. Increased production.
3. Early crop maturity (4-5 days).
4. Long and shining grain is obtained good grain quality.
5. More fodder available for cattle.
6. No/ lesser disease incidence and insect infestation.
7. Less seed requirement 75-80% seed saving (Only 25-30 kg/ha).
8. Weeding facilitated good aeration to roots
9. Less water requirement (20-30%)

Constraints in SWI
1. Need to design and develop suitable sowing implement.
2. Unavailability of suitable weeder to the farmers.
3. Capacity building of farmers in adoption of SWI
4. To ensure irrigation at critical stages of crop growth
5. Intensive scientific study need to be done at research station

Conclusion
System of Wheat Intensification Method of wheat cultivation has shown positively response on all measured growth parameters, yield characters and yield production compared to conventional method. It shows positive response for seed treatment and wider space sowing. The SWI technology has already established its strength in terms of multiple benefits like enhanced productivity per unit land, water and other inputs with higher economic gain. This technology also save seed requirement about 75-80% (Only require 20-25 kg/ha). Thus we can say that this technology can be solve the seed problems. However, more detail study is needed on various agronomic and other bio-physical changes in the plants under SWI method. Finally, more skill-oriented training for the SWI farmers is required to build up their confidence.

References
1. Dhar S, Barah BC, Vyas AK. Comparative performance of System of Wheat Intensification (SWI) and other methods of wheat cultivation in north western plain zone of India. In: International SRI Research seminar on recent Changesin Rice Production and Rural Livelihoods: New Insights on the System of Rice Intensification (SRI) as a Socio-Technical Movement in India. Indian Agricultural Research Institute, New Delhi; c2014.
2. PRADAN. cultivating wheat with SRI Principles: A manual. System of Rice Intensification website; c2012.
3. Rana Lalita, Banerjee Hirak, Ray Krishnendu, Sarkar Sukamal. System of wheat intensification (SWI) – A new approach for increasing wheat yield in small holder farming system. Journal of Applied and Natural Science; c2017. 9. 1453-1464. 10.31018/jans.v9i3.1384.
4. Ravindra Singh, Bipin Upadhya, Sadhna Singh, Shashank Shekhar Singh. Economics of Wheat Cultivation in Basti District of Eastern Uttar Pradesh, Int. J. Curr. Microbiol. App. Sci. 2018;(Special Issue-7):1131-1138.
5. Kaur G, Dufour JM. Cell lines: Valuable tools or useless artifacts. Spermatogenesis. 2012 Jan 1;2(1):1-5.