

Wheat production

by system of wheat intensification technique

P Suryavanshi¹ and Y V Singh²

Indian Agricultural Research Institute, New Delhi 110 012

System of wheat intensification has been adopted in wheat production as it follows a more comprehensive approach addressing various management practices simultaneously with promising results. This technology has many advantages over the conventional system and shows better and higher yields with lower inputs, thus providing more economic benefits. Thus, system of wheat intensification is well suited for small- and marginal-farmers and can effectively bridge the yield gap in wheat.

Key words: Intensification, Production, Technique, Wheat

WHEAT is the second most important crop in India and a principal source of calorie intake. Cultivation of wheat has been the symbolic of Green Revolution as it has played pivotal role in making India a food surplus nation. Wheat production was recorded as 95.91 million tonne from an area of 30 million ha during 2013-14. It also supplies 21% of the per caput food energy and 18% of dietary protein in the country. Three of the wheat growing states (Uttar Pradesh, Punjab and Haryana) account for nearly 80% of the total wheat production of the country. During past few years, the overall wheat productivity has become stagnant and yield gap of nearly 70 kg ha⁻¹ between research farm and farmers' field, thus indicating the need to increase its productivity.

Due to fragmentation of land holding, area operated by small-and marginal-farmers has increased from about 19% to 44% during post-independent era and nearly 48% of the production increment (46 million tonne) of wheat came from these smaller holdings. It is estimated that India by 2030 will require approximately 100 million tonne of wheat to cover an estimated demand

of 345 million tonne of foodgrains. So, technologies which can increase wheat yield substantially as well as suitable for a vast majority of resource poor farmers should be developed. In this context, in many parts of the third world countries is seeking attention on System of Wheat Intensification from both researchers and farmers.

System of wheat intensification

System of Wheat Intensification popularly known as 'Sri Vidhi Gehun' is a new concept and practice of wheat cultivation involving manipulation of the soil environment favorably for better root and shoot growth using principles of System of Wheat Intensification. It is simply an adoption of technique used in the System of Wheat Intensification SWI methodology of increasing the productivity of crops by changing the management of plant, soil, water and nutrients while reducing external inputs use.

Principles of the system of wheat intensification: System of Wheat Intensification is primarily based on following two principles of crop production: (i) Principle of root development and (ii) Principle of intensive care.

(i) Principle of root development:

Root development is the first step of healthy growth and development of any plant. For this, it requires proper nourishment and sufficient space around the plant. So, distance between plants is very crucial for proper growth and development of crop plants.

(ii) Principle of intensive care:

Intensification does not mean high number of plant density per unit space; rather it is proper space maintenance and taking care of plants very closely. So, to enhance productivity it requires intensive care in every stage of plant growth specially management of weed, insect, disease, organic manure and irrigation.

Modified package of practices for achieving higher productivity

Improved seed: With System of Wheat Intensification, there is no specific preference for any particular variety of seed, but it is better to use fresher seeds, while getting rid of older ones.

Seed treatment and priming of seeds:

Seed treatment and seed priming generally improves germination and help in early emergence of seedlings. For priming, wheat seeds may be



Fig. 1 a-e. Seed treatment and priming

soaked in water for 6-8 hr and then dried in shade before sowing. It is a low risk and low cost practice which can add the uniformity and timelines of crop establishment in many circumstances. Seeds are treated with organic mixture of well decomposed compost, jaggery and cow urine for improving microbial activity in the soil. Germinated seeds are used for sowing in the field. The materials required for priming of seeds for 1 acre (0.404 ha) are: 10 kg of seeds; 20 liters of warm water; 5 kg of vermin compost; 4 kg of jaggery (coarse sugar); 4 liters of cow urine; and 20 g of Bavistin broad spectrum systemic fungicide containing carbendazim (50% wp).

Priming of seeds

Procedure for priming of seeds and seed treatment

1. Remove any pebbles and mud particles from the seeds.
2. Heat the water upto 60°C.
3. Put the seeds in to the warm water.
4. Remove all floating seeds and particles from the water
5. Add vermicompost, jaggery and cow urine to the water and leave the mixture for 8 hr.

6. Recover the good seeds from the water and throw away the solution water.
7. Mix Bavistin with the seeds and put them inside a moist gunny bag for 12 hr for the seeds to sprout. Such priming of seed helps in the good growth of the plant and provides strength.
8. Use the germinated seed for sowing in the tilled field.

Land preparation and application of organic manure: System of Wheat Intensification emphasizes on efficient use of organic manure rather than chemical fertilizers because it helps to improve the soil health in addition to providing nutrients to the crop.

- Two tonne of farmyard manure or 0.4 tonne of vermicompost should be applied per acre. This is necessary as the stand-alone use of chemical fertilizers reduces the productivity of the soil over time.
- If the soil moisture is insufficient, provide some supplementary irrigation before tilling the land.
- Apply 27 kg of di-ammonium phosphate (P_2O_5) and 13.5 kg of muriate of potash (K_2O) in the soil before the last ploughing.
- Plough the field well, so that the

soil is well pulverized for easy root growth.

The following points should be considered for proper compost making:

- Farmyard manure should be protected from rainwater because it leaches the nutrients.
- Farmyard manure should be protected from sunlight to prevent volatilization of ammonia.
- Cattle urine should be collected and utilized properly.
- Only well prepared farmyard manure should be used in the field.
- Farmyard manure should be incorporated in the soil properly.

Sowing by using SWI methods

Seed rate: It is lowered to 10 kg/acre (25 kg/ha). Treated seeds have high germination rate. So, sowing treated seeds in lines 20 cm apart saves a large amount of seed and reduces the cost incurred in it.

Line sowing: Maintaining plant to plant distance is important for facilitating proper root development and tillering in wheat crop. So, place two sprouted seeds in the inter-sections where the marked furrows meet with 20 cm × 20 cm² between them. Thus the spacing will be 20 cm



Fig. 2a,b. Seed sowing in field.



Fig. 3. Crop raised by SWI technique

in between rows and also between plants (20 cm × 20 cm). After placing the seeds, cover them with some loose sand.

Gap filling: Wherever the seeds have not germinated, the gap should be filled with germinated seeds within 10 days of sowing.

Irrigation: First irrigation is done 15 days after sowing, as root initiation starts during this time. Unavailability of moisture in soil prevents root initiation. If the soil is not moist, the plant will not develop its roots and becomes stunted. Second irrigation is given 25 days after sowing, as tillers start emerging in this stage. Third irrigation is given 35 to 40 days after sowing. After that the plants grow profusely and tillering continues. During the flowering and grain-filling stage, appropriate moisture should be available in the soil. For proper growth and grain filling irrigate the plot on 60, 80 and 100 days after sowing. Irrigation timing should be adjusted to soil and agro-climatic conditions. If irrigation is not provided during flowering and grain filling, there will be drastic reduction in the yield of the crop.

Fertilizer application: After first irrigation, apply a dose of urea (40 kg per acre 0.404 ha) and vermicompost (400 kg/ha) on the 16 day, while there is still moisture in the field. The second dose of urea (15 kg/ acre (0.404 ha) and 13 kg/acre (0.404 ha) of potash (MoP) should be applied immediately after third irrigation (35-40 days after sowing)

Weeding: Two-three days after the first, second and third irrigations, hoeing and weeding should be done using cono-weeder to loosen the soil and to make the wheat field free from weed. The loosening of soil results in

Table 1. Difference between system of wheat intensification and conventional method of wheat cultivation

Parameters	Conventional method	System of wheat intensification (SWI)
Seed rate	100 kg/ha	25 kg/ha
Seed treatment	Not done	Bavistein, cow dung, urine and jaggery
Sowing method	Broadcasting	dibbling
Spacing	20 cm×10 cm	20 cm × 20 cm
Germination in field	1 week after sowing	2-3 DAS
Leaves	Thin, less LAI	Broad, more leaf area index
Stems	Thin	Thick
Roots	Shallow	Deep and luxurious growth
Yield	3.5 tonne /ha	5.1 tonne /ha

LAI, Leaf area index; DAS, Days after sowing

better aeration for the root zone and increases the root length by letting them take more moisture and nutrient from the soil. This helps in bringing forth more tillers in the plant with more vigour. Cono-weeder is a manually operated machine used for weeding between rows of paddy or wheat crop. It has two conical rotors mounted in tandem with opposite orientation. Smooth and serrated blades mounted alternately on the rotor uproot and bury weeds because the rotors create a back and forth movement in the top 3 cm of soil, the cono-weeder can satisfactorily weed in a single forward pass without a push or pull movement.

Better yield in SWI method

- Crown roots which develop about 20 days after sowing spread out horizontally for nutrients and water. If the soil is hard, the young plants cannot spread out their root network for acquiring water and nutrients. This stunting effect on plants induced due to hard soil is known as the 'Bonsai Effect'.
- Mechanical weeding applied with SWI methods loosens the soil and helps in aeration. This helps to control weeds, helps roots to grow, and enhances moisture and nutrient uptake from the soil.
- Priming of seeds ensures protection for the crop from diseases.
- Cow urine is powerful natural manure for providing nutrients to the seed.
- Planting far apart means that each seedling has lots of light and plenty of space to obtain nutrients and water.

ADVANTAGES

The advantages include reduced seed rate; profused tillering, higher spike length and increased test weight leads to 25 to 50% more grain yield; increases NUE and WUE; SWI maximizes labour factor productivity in the marginal-land; weed problem can be minimized to the maximum extent using cono-weeder; pest and disease incidence can be lowered due to free canopy aeration created by wider spacing; soil fertility is maintained and improved due to organic matter application and better microbial activity; cost of production is lowered as compared to conventional system; and problem of resistant weed to herbicides can be minimized.

SUMMARY

System of wheat intensification is intended to help small-and marginal-farmers with limited resources to produce higher yield with increased monetary returns. It is a real bottom up technology which is adopted on a large-scale by farmers after being promoted by NGO's and other government agencies.

Future strategy should conduct extensive field research in agricultural universities and research stations so that new interventions can be done to make this technology more remunerative for resource poor farmers in a sustainable manner.

¹Senior Research Fellow, and ²Principal Scientist, CCUBGA. Corresponding authors' e mail: suryavanshipriyanka53@gmail.com