SYNOPSIS

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"System of Wheat Intensification: Low Input technology to increase the wheat yield"

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Department of Agronomy

School of Agriculture

Lovely Professional University

Punjab (India) 144411

Submitted By

Kavita

11719432

UNDER GUIDANCE OF

Dr. Mayur S. Darvhankar

School of Agriculture

Lovely Professional University

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CERTIFICATE

This is to certified that the synopsis entitled **System of Wheat Intensification: Low Input technology to increase the wheat yield** submitted in partial fulfillment of requirements for degree of Master of Science (M.Sc.) in Agronomy by **Kavita** to Department of Agronomy School of Agriculture, Lovely Professional University, has been formulated and finalized by the student himself on the subject.

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(Signature of Student)	(Signature of Supervisor)
Kavita	**Dr. Mayur S. Darvhankar**
11719432	UID: 21878
	Designation: Assistant Professor
	Department of Genetics and Plant Breeding
	School of Agriculture
	Lovely Professional University

DECLARATION

I hereby declare that the project work entitled **System of Wheat Intensification: Low Input technology to increase the wheat yield** is an authentic record of my work carried at **Lovely Professional University** as requirements of project work for the award of degree of Master of Science in Agronomy, under the guidance of **Dr. Mayur S. Darvhankar**, Assistant Professor, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India.

Kavita

11719432

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INTRODUCTION

Botanical Description of Wheat

Wheat (*Triticum spp.*) is the most widely cultivated food crop of the world and is known for its remarkable adaptation to a wide range of environments and high nutritive value. It is also the largest single agri-trading commodity with a great impact on world economy. Wheat is the second most important staple food next to rice, consumed by nearly 35% of the world population and providing 20% of the total food calories. It is the most widely cultivated food crop of the world.

Wheat occupies about 32% of the total acreage under cereals in the world. The wheat is cultivated throughout the year in one or the other parts of the world. The main wheat growing countries include China, India, U.S.A., Russia, France, Canada, Germany, Turkey, Australia and Ukrain. In India, wheat is mainly grown in the states of Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, Haryana, Bihar, Maharashtra, Karnataka and Gujarat. India accounts an area of 29.25 million ha and production of 85.93 million tones with a productivity of 2937 kg/ha. In Gujarat, wheat is grown in about 1.3 million ha with total production of 3.9 million tones and a productivity of 2990 kg/ha (Anonymous, 2010-11).

Taxonomic description of wheat

The wheat belongs to the genus *Triticum* of the family Poaceae and its origin is believed to be Middle East Region of Asia (Lupton, 1987). In fact, there are three natural group of wheat from polyploid series with chromosome number n=7, 14 and 21. Among them, *Triticum aestivum* L. (bread wheat), *Triticum durum* Desf. (macaroni wheat) and *Triticum dicoccum* Schulb. (emmer wheat) are presently grown as commercial crop in India. In India, about 86% of the wheat grown area is under bread wheat, 12% under durum wheat and the remaining 2% under emmer wheat. The bread wheat, a hexaploid with chromosome number 2n=42 is cultivated in all the wheat growing areas of the country, the macaroni or durum wheat (tetraploid, 2n=28) is mostly grown in the Northern (Punjab) and Southern states, while the emmer wheat (tetraploid, 2n=28) is confined to the Southern states (mainly Karnataka) and some parts of Gujarat.

Wheat is a unique gift of nature to the mankind as it can be moulded into innumerable products like chapatis, breads, cakes, biscuits, pasta and many hot and ready-to-eat breakfast foods. Wheat grain contains starch (60-68%), protein (6-21%), fat (1.5-2.0%), cellulose (2.0-2.5%), minerals (1.8%) and vitamins. The uniqueness of wheat in contrast to other cereals is that wheat contains gluten protein which enables leavened dough to rise by forming minute gas cells and this property enables bakers to produce light breads.

Present Status:

In recent years, wheat research has concentrated on increased yield, earliness, grain quality and disease resistance especially the leaf and stem rusts. India has made tremendous progress in wheat production and productivity by evolving high yielding varieties (Chopra, 2001). These varieties were very successful in increasing the wheat production from a 12.5 million tonnes in 1964 to 85.9 million tonnes in 2010-11. During the last 30 years, there has been a 1% annual genetic gain in yield of new varieties. However, still there is a wide scope for increasing the inherent productivity potential of presently grown varieties by way of using various breeding methods and statistical techniques for genetic analysis, which are being practised in self-pollinated crops. This may help in achieving 2% increase in annual genetic gain which is anticipated to fulfill the food requirements of the country.

It is now believed that the yield levels of the present semi dwarf wheat have reached a plateau due to inadequate exploitation of gene pool in relation to study the genetic architecture of important traits affecting yield. The major objective in most wheat breeding programmes is to improve the genetic potential for grain yield, which is mainly determined by three components viz., number of tillers per plant, number of grains per spike and grain weight. The knowledge of nature and magnitude of fixable and non-fixable type of gene effects, governing the yield and its components, is essential in order to formulate an efficient breeding programme to achieve the maximum genetic improvement in this crop.

Complex physiological process determine grain yield and there is a great role of environment, which influences the yield. Temperature and short winter growing season in Central India are main factor for yield in wheat. High temperature increases the rate of grain filling but, the duration of grain filling is reduced considerably and grain weight is decreased

(Sofield *et al.*, 1977 and Wardlaw *et al.*, 1989). Early sowing of wheat may escape from high temperature during grain filling but high temperature at time of sowing affect germination and early vegetative growth. Therefore, identification of wheat genotype and treatments suitable for specific sowing condition is of great importance for achieving higher yield.

System of Wheat Intensification (SWI)

Introduction of semi dwarf varieties increased the consumption of fertilizer per unit area tremendously and promoted mechanization in agriculture. In one side it increased the over all production and postponed the near seen dangerous cloud of the great famine due to population explosion in the third world where there was very low growth rate of crop production as compared to population growth. However in long term advantages of green revolution were taken only by developed country and farmers who were fortified by irrigation, mechanization and high agro inputs. But at initial decades of 21st century another probability of great famine appeared in the world due to long drought in tropical and subtropical and at the same time it appeared more dangerously because most of the developed countries adopted policies of using consumable grains into biofuel production. Therefore another very serious initiative was needed to increase the productivity of major crop in the very marginal land with low input and sustainable way. In this context, in many parts of the third world System of Rice Intensification created government attention. This technology has high potentiality to provide high yield per drop of water and per kg of agricultural inputs like fertilizer, seed etc. Some community workers in India and Africa use the same principle of rice cultivation in wheat crop, which gave very enthusiastic results. This technique of wheat cultivation is now known as System of Wheat Intensification (SWI).

REVIEW OF LITERATURE

Sharma *et al*. (2008) formulated a practical strategy for promoting the SWI technique in HP. PSI made a commitment to cover about 500 farmers under SWI in three districts (Bilaspur, Kangra and Sirmour) of Himachal Pradesh. WWF- ICRISAT, Hyderabad, provided the financial assistance for the proposed expansion of the SWI experiment. PSI successfully undertook the SWI programme from November 2008 to May 2009, in which about 470 farmers experimented with the SWI technique in the three selected districts. Higher yield compensated for higher SWI costs of cultivation.

Styger (2009) Wheat yield for SWI direct seeded was 13% higher compared to the control. Significant improvement with SWI was obtained in labor and water productivity. Labor requirement for SWI was reduced by 35-40% compared to the control. The return to labor (wheat produced per unit of labor) under SWI SD increased by 74% over the control.

Saha (2009) An experiment was conducted to study the effect of crop diversification and intensification in rice- wheat cropping system on production potential, profitability and energy use efficiency on sandy clay loam soil reported more productivity by replacing wheat in rice wheat cropping system with vegetables Inclusion of pulses in crop sequence increased the grain yield of both the crop sequence.

Thapa (2011) shows that wheat crop responds positively to seed priming, line sowing, and wider spacing. The wheat variety WK 1204 is highly productive compared to the local variety and is suited for the climate of the mid-hills. Reduced plant population (with increased spacing of plants 20cm x 8cm) is crucial for increasing the number of tillers per plant, plant height, and spike length, as well as the number and size of grains, all of which result in higher grain and biomass yield. SWI management used on 0.25 Hectare of land with improved variety, seed priming, line sowing and wider spacing can increase yield by as much as 100%, which can contribute for adding 6 months of household food security assuming a six-member household.

Dhar (2012) compared the performance of wheat under System of Wheat Intensification (SWI) and standard recommended practices (SRPs). Differences in yield attributes and root traits were also observed in favor of SWI. Available N, P, and K in the soil after harvesting was increased with SWI, whereas depletion in nutrients with the SRPs indicated the scope for SWI sustaining soil fertility. Higher yield compensated for higher SWI costs of cultivation.

Pisante (2012) paper provides a review of agronomic management practice supporting sustainable crop production systems and intensification and testifying to developments in the selection of crops and cultivars. This describes crop farming systems taking a predominantly ecosystem approach it discusses the scientific application of this approach for the management of pest and weed populations.

Rawandha (2012) The recent Crop Intensification Program represents a great opportunity for Rwanda to guarantee food security and strengthen the country`s agricultural productivity. However overwhelming evidence is arising that a sustained growth path will be preserved over time only if the production process incorporates sustainability issues. Through qualitative interviews, a quantitative analysis and findings from the literature we will assess the sustainability of the current Rwanda Crop Intensification Program formulation and will analyze the interventions that are needed to reconcile immediate food security needs and long run environment proof methods of crops production.The result of rawanda project SWI gives the better result in sustainable crop production.

Uphoof (2012) in his booklet 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.

Adhikari (2013) Average plant height was 61.5 cm. at 65 Days after Sowing. The results of this study showed that plant height, numbers of tillers/ hill, number of productive tillers, panicle length, and production were found higher in SWI method. Yield of wheat variety (Bhirkuti) was found 2.6, 2.4 and 2.3 kg/4 m2 in SWI, Line sown and broadcast practices, respectively.

Chopra and Sen (2013) reported grain yield of wheat similarly in comparison with broadcast method of sowing .the result of experiment conclude that the yield by SWI method is more than conventional method.

Abraham *et al.* (2014) reported an increase of 18-67% grain and 9-27% straw yield of wheat at farmer’s 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.

Keil (2015) In the context of the dominantly irrigated wheat production systems of Bihar without adoption of ‘full’ conservation agriculture (i.e. ZT in combination with soil cover from crop residues), we conclude that farmers reap substantial yield and monetary benefits from ZT practices, both in upland and lowland ecologies. The practicality of early sowing of wheat varies across agro-ecological zones due to temporal differences in soil drainage, which needs to be considered when targeting extension messages. Nevertheless, our findings imply that the potential of ZT to facilitate an advancement of wheat sowing can be exploited in well-drained areas.

Abate (2016) The use of material inputs, farmers in the full package group were much more likely to use improved seeds and received quality fertilizer from the Wheat Initiative than the control group; We find that full package farmers far more likely to apply gypsum to their fields than control group or marketing group farmers, but no more likely to use pesticides or herbicides. In terms of techniques, we find that full package farmers did reduce seeding rates and were more likely to try row planting than control group farmers, who also appear generally aware of the Wheat Initiative recommendations. The result conclude that number of productive tillers, panicle length, and production were found higher in SWI method.

Rakib (2016) The data set for all plant characters was statistically analyzed considering fertilizer dose as a source of variation in addition to the line and plant spacing. It has been observed that the main effects of fertilizer dose and interaction effect between fertilizer dose and line spacing, fertilizer dose and plant spacing and three-factor interaction i.e. fertilizer dose, line spacing and plant spacing were significant ($P < 0.01$) for the number of grains per spike, grain and straw yield and harvest index.

Bhargwa *et al*. (2016) suggested 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. They also suggested that SWI methods are superior than conventional line sowing of wheat with improved recommended practices and far superior to usual farmers practice.

MATERIAL AND METHOD

A. Experimental Site:

The experiment site is located Agriculture Research Farm at Lovely Professional University, Phagwara.

B. Materials Preparation:

The experiments were conducted with 18 plots following 3 replication. Spacing for SWI 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 3 kg of seedling 2 litre of luke warm water to remove lighter seed and sand impurities.

After pouring the seed were stirred an floating seed and impurities were removed by sieves or by hands. Then 0.55 litres of cow (indigenous) urine, 250 gm of jaggery and 200gm of vermicompost were added with 2 litres of water and thoroughly mixed with seed containing water. The mixture was left for 8-10 hours and then filtered. The seeds were swollen. The swollen filtered seeds were treated with Carbendazim 0.55gm/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. Wherever seeds had not germinated, gap should be filled with germinated seeds within 10 days of sowing. 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 6 months by flood irrigation. Fertilizer requirement for irrigated timely sown wheat N 100,P 60,K 40.

C. Experimental details:

1. Year of experiment : 2017-2018
2. Recommended dose of fertilizer : 100:60:60 kg N,P,K/hec
3. No. of treatments : 6
4. No. of replication : 3
5. Total no. of plots : 18
6. Plot size : 4.8m x 3m
7. Dates of sowing : December 2018

8. Experiment design : Randomized complete block design (RCBD)

9. Crop and variety : Wheat (Basi)

10. Spacing : 22.5 cm (RXR)

D. Treatment details

T0	Control
T1	Sees treatment with CSR-BIO formulation+Soil application @5kg/100FYM
T2	25% RDF + T1
T3	Seed treatment with Jaggery solution
T4	25% RDF + T3
T5	100% RDF
T6	Control without any organic and inorganic fertilizers

E. Collection of sample:

Soil sample was collected for analysis to check soil status (pH, N, P, EC and Organic carbon) of experimental field before crop season.

F. Soil Analytical method to be followed during investigation are as under

S No.	Test parameter	Method	References
1	pH(1:2.5)	Glass electrode	Spark (1996)
2	EC(1:2.5)	Conductivity meter	Spark (1996)
3	Organic carbon	Wet digestion	Walkely and black (1934)
4	Available N	Alkaline potassium permagnate method	Subbiah and asija (1956)
5	Available P	Oslen' method	Oslen *et al*. (1954)
6	Available K	Flame photometer	Jackson (1973)

G. Observations to be recorded:

Following observation were recorded at 15, 30, 45 and 60 DAS by following standard protocol

1. Growing Degree Days (GDD)
2. Leaf Area Index (LAI)
3. No. of tillers per plant
4. No. of grains per spike
5. No. of spikes per meter square
6. 1000 grain weight
7. Grain yield
8. Straw Yield

G) Statistical Analysis:

The data will be statistically analyzed by using ANOVA of randomized complete block design and Per-se performance.

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