"Effect of Pendimithalin and Chlorimuron ethyl on nodulation, N_2 fixation, NPK uptake and yield of Soybean (*Glycine max L.*) and its residual effects on microbial count"

THESIS

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Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior
In partial fulfilment of the requirements for the
Degree of

MASTER OF SCIENCE

In

AGRICULTURE

(SOIL SCIENCE & AGRICULTURAL CHEMISTRY)

By

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CERTIFICATE – I

This is to certify that the thesis entitled "**Effect of pendimithalin and chlorimuron ethyl on nodulation, N_2 fixation, NPK uptake and yield of Soybean (*Glycine max L.*) and its residual effect on microbial count.** " submitted in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in AGRICULTURE (SOIL SCIENCE & AGRICULTURAL CHEMISTRY**) of Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior. is a record of the bonafied research work carried out by **RAMKUMAR SINGH BHADAURIA, ID No. A/GW/922/2006** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instruction.

No part of the thesis has been submitted for any other degree or diploma (Certificate awarded etc.) or has been published / published part has been fully acknowledged. All the assistance and help received during the course of the investigation has been acknowledged by him.

(Dr. S. K. Dubey)

Chairman of the Advisory Committee

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CERTIFICATE – II

This is to certify that the thesis "**Effect of pendimithalin and chlorimuron ethyl on nodulation, N_2 fixation, NPK uptake and yield of Soybean (*Glycine max L.*) and its residual effect on microbial count.**" submitted by **RAMKUMAR SINGH BHADAURIA, ID No. A/GW/922/2006** to the Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, in partial fulfillment of the requirements for the degree of **Master of Science in Agriculture** in the Department of **Soil Science & Agricultural Chemistry** has been, after evaluation, approved by the External Examiner and by the Student's Advisory Committee after an oral examination on the same.

Dr. S. K. Dubey
Chairman
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Place: Gwalior
Date:

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Place: Gwalior

(Ramkumar Singh Bhadauria)

CONTENTS

List of Tables

List of Figures

CHAPTER – I
INTRODUCTION

Soybean [*Glycine max (L*.) merrill] is one of the most important *Kharif* oilseed crop of Madhya Pradesh. Besides high yield potential (25-30 q/ha), it also provides cholesterol free oil (20%) and high quality protein (38-42%). It is rich source of amino acid, vitamins, minerals, fats and dietary value. Besides having dietary value and being a leguminous crop, it is capable of fixing atmospheric nitrogen at the rate of 85-115 kg/ha/year (Alexader, 1977) with symbiosis through *Rhizobium japonicum* bacteria, after fulfillment of its requirement.

Having approximately 80% share in national area and production of soybean, Madhya Pradesh has distinguished as '*Soya State'*. Now, this crop has occupied a vital place in agricultural and oil economy of the country.

The total area under soybean crop grown in India is 9.30 million hector and production 9.80 million metrics tons (2010 – 2011). In M.P. soybean is grown in 5349 thousand hectors and production 64.06 thousand tons (2010-11).

The productivity of the crop is affected by many factors viz. crop genetics, management and climatic factors. Among the various factors responsible for the low yield weeds have been considered to be of prime importance. The total annual loss of a agriculture produce from various pests in India, weeds account for 45%, insect 30%, disease 20% and other pests 5%. The losses caused by weeds exceed the loss from any other category of agricultural pests (Subramanium *et al.,* 1995).

The most favorable agro-climatic condition in the region encourages growth of weeds causing serious decline in its yield, Compaction of weeds for moisture, nutrient, space on sunlight greatly affects the growth, yield atribuits and ultimately reduce the yield of crop. Reduction in yield depends upon the type's intensity of weeds as well as their time of occurrence (Muniappa *et al*.1986).

In M.P. soybean is extensively grown during rainy season (*kharif*). There is a conductive atmosphere an excessive weed infestation up to September. The excessive occurrence of weeds limits the full expression of yield potential of this crop. Thus, an early control of weeds (first 30 days) in soybean is very critical and if

not done the yield losses may reach up to 43 %. Once soybean develops its foliage canopy and covers the ground area, it can take the potential of soybean varieties even with adoption of improved cultivation technology involving use of all valuable inputs, cannot be obtained in the absence of proper weed management

Soil micro organisms play an important role in nutrient cycling with in soil-plant ecosystem. During decomposition of organic matter, CO_2 and inorganic plant nutrients such as nitrate, phosphate and sulphate are released which the plant can use. The fertility of natural soil depends on the rate of turnover of organic matter brought about by the activities of the soil fertility which depends on the soil microbial processes such as nitrogen fixation, mineralization of nitrogen, phosphorus and sulphur and organic matter transformation.

Pesticides have an important role in farming system for weed management as well as pests and disease management. It is well known that herbicide use now become an essential practice in soybean. Therefore, evaluation of herbicidal effect is essential to ensure optimum functioning of soil biota, nutrient availability and plant growth. In view of above the experiment is conducted with the following objectives.

Objectives:

1. To see the impact of different herbicide on nodulation, N_2-fixation in soybean crop
2. To study the effect of different herbicide on NPK content pattern in the plant, soil and balance of these nutrients.
3. To see less harmful dose of herbicide for soybean in relation to *Rhizobium* population.

CHAPTER - II
REVIEW OF LITERATURE

Review of literature is a necessary step for any scientific study. It provides a theoretical framework, previous work and the basic interpretation of finding to the study. An attempt has been made to review the literature, which is meaningful and had direct relevance to this study. The available research has been presented under the following head.

2.1: Effect of herbicide on symbiotic trail and N_2 fixation

Akhter *et al.* (1990) observed that application of pre emergence pendimithilian @ 3.75 l/ha and post emergence fluazifop-butyl @ 4.0 l/ha. Weedicide decreased the root nodulation of soybean.

Pandey and Rai (1995) observed that the application of herbicides at the recommended rate except butachlor increased the number of nodules/plant and twice the recommended rate; higher rates all herbicide gave similar or lower number of nodules /plant compared with the control.

Ahmad *et al*. (1996) reported that the use of benthiocarb and methabenzithiazuron yielded the maximum number of nodules and menthabenthiozuron also yielded a significant higher nodule weight of soybean c.v. JS-2.

Billore *et al.* (2001) found that the maximum and minimum nodules were associated with application of fenoxoprop-p ethyl @ 70 g/ha and 2-hand weeding, respectively. The nodule dry weight was maximum in 2-inter cultivation, whereas it was minimum in weedy control.

Anikwe *et al.* (2003) studied that the both post emergence and a combination of pre and post emergence herbicide treatment applied at 3 weeks after planting, reduced the nodulation, shoot dry weight and N accumulation in the biomass. Pre emergence herbicide application reduced weed density and sparingly affected nodule dry weight and N accumulation in plant of soybean.

Gupta and Roget (2005) observed that application of some grass broadleaf herbicide in pulse (peas and vetch) reduced nodulation and nitrogen fixation in Mallee soils and herbicides which causes yellowing in pulses and medics

are highly likely to be reducing the number of effective of nodules and nitrogen fixation. However, weed management should not be compromised where weeds were the main factor affecting crop yields.

2.2: Effect of herbicides and weeding method on attribution and yield of soybean

Thakur *et al*. (1998) observed that hoeing + hand weeding twice gave the maximum of branches per plant, dry matter per plant and seed yield.

Godara and Deshmukh (2000) reported that post emergence application of imazathapyr @ 75 g/ha at 25 DAS, gave higher grain yield over other herbicides.

Shan *et al*. (2000) found that application of pendimithalin @1.0 kg/ha recorded higher yield of soybean (2140 kg/ha.) in comparison one hand weeding (1971 kg/ha.).

Kushwah and Kushwah (2001) found that pendimithalin @1.0 kg/ha. PE + hand weeding resulted in significantly higher growth, yield attributing characters and seed yield over rest of the methods including farmers practice.

Bhan *et al*. (2002) observed that the crop yield of soybean was highest (1597 kg/ha.) in weed free plot, which received 2 hand weeding at 20 and 40 DAS pendimithalin @ 1.0 and 2.0 kg/ha produced soybean seed yield that was at per with weed free plots.

Chamale *et al*. (2002) recorded that pre-emergence application of ethir pendimithaline or fluchlorin @1.0 kg/ha. With one hoeing at 40 DAS recorded significantly higher grain and stow yield. Higher yield attributed to maximum plant height, number of branches and number of leaves/plant. The quality parameters like test weight, oil and protein content in seed were significantly increased.

Rajput and Kushwah (2004) reported that two hand weeding done at 20 and 30 DAS gave highest seed yield (1860 kg/ha.) and net return (Rs 8086). This was

followed by pre emergence application of pendimithalin @1.0 kg/ha supplemented with one weeding at 30 DAS.

2.3: Effect of herbicide on nutrients count its uptake and residual effect on soil

Singh and Sharma (1989) reported that the uptake of NPK by total weeds was reduced while uptake by crop was increased at narrow row spacing compared to wide row spacing. The highest; nutrient uptake by weeds and the lowest uptake by crop occurred in control plots. Crop take up the highest quantity of these nutrient in the alachlor (2.5 kg/ha) or 2manual weeding (20 and 40 DAS) treatment.

Pandey andrai (1995) observed that the uptake of nitrogen was the recommended dose or twice recommended dose of carbofuron herbicide.

Panneerselvam *et al*. (2000) reported that the application of biogas slurry + 30:120:40 kg NPK gave the highest P uptake by soybean. During the early growth stage (20 DAS), uptake was highest with alachlor, followed by pendimithalin. At latter stage (40 and 60 DAS and harvesting) hand weeding twice considerably increased P uptake. Soil available P was the highest in plots biogas slurry + 30:120:40 kg NPK, hand weeding increased the availability of P in soil, followed by alachor + hand weeding.

Jat *et al.* (2002) observed that the highest nutrient uptake was obtained under 2 hand weeding, followed by metolaclor and pendimethalin maize and soybean crops. Fertilizer level applied to soybean and *Rhizobium* inoculation to soybean but failed to show and effect of maize

2.4: Effect of herbicide on biological health of the soil

Bogdanovic (1991) observed that the application of alachlor + linuron and pendimithalin + linuron reduced the soil micro flora in soybean fields by 15 and 75 %, respectively. All herbicide tested increased the micro flora associated with soybean

nodules by 12-437 % the autumn, alachlor + linuron had reduced the micro flora by 69 %.

Harris *et al*. (1995) evaluated that the number of actinomycetes, algae, bacteria, fungi and nitrifies during the soybean growing season in a wheat – soybean double cropping system. Residue burning and tillage had no effect on number of bacteria and nitrifers. Non disturbed plots had greater numbers of actinomycites, algae and fungi 7 days after herbicide application each year, bit increase generally did not persist through the season. Herbicide application had no effect on microbial numbers.

Razuddin Ahmad *et al.* (2004) reported that the bacterial population decreased in all the herbicide treatments at 30 DAS maximum decline in bacterial population was noticed in pendimethalin treated plots followed by oxyfluorfen. However, the lost bacterial population was recovered at harvest time. Maximum fungal population was recorded with unwedded (control). Plot where the herbicides applied to soybean decreased the fungal population at 30 DAS and at harvest increase in microbial population from seedling to harvest stage was observed in all the herbicide treated plots.

Singh *et al*. (2004) reported that chlorimuron-ethyl at various doses (6, 9, 18 g/ha) was effective on non grassy weeds in soybean without any phytoxicity. Chlorimuron-ethyl and at 9g/ha was better than 6g/ha application at 2or 7 DAS. Grain yield to chlorimuron-ethyl at 9g/ha applied at 3 or 7 DAS were at with weed free treatment.

Bhera *et al*. (2005) reported a field experiment was carried on clay loam soil of Indor, Madhya Pradesh. The pre-emergence application of herbicides, metaclocher @1.0 kg/ha, chorimuron-ethyl @0.009 g/ha and chlorimuron-ethyl @ 0.009 g/ha + metolachor @1.0 kg/ha, were equally effective in controlling the seeds and increasing the yield of soybean.

Gupta and Roget (2005) reported that soil with a healthy biota could recover from short-term negative effects of herbicide application use of herbicides could be

less destructive to soil biota if management practices that improve biological activity are promoted.

Choudhari *et al.* (2010) reported that the population of herbicide influenced the soil biological activities. All the herbicide were found to be more effective inhibitors against fungal population which was also affected, while actinomycetes had negligible effect, two hand weeding in soybean in enhanced yield without affecting microbial population in soil.

Sebiomo *et al.* (2011) studied the effect of four herbicide (atrzine, primmextra, paraquat and glyphote) on soil microbial population, soil organic matter and dehydrogenize activity was assessed over a period of six week. Soil sample from were treated with herbicide at company recommended rates. Soil dehydrogenize activity was measured at four day sampling intervals up to the 20^{th} day Bacterial, fungal and actinomycetes population decreased upon treatment with herbicide when compared to the control.

CHAPTER – III

MATERIAL AND METHODS

The present investigation was carried out during *Kharif* of 2011 at the research farm Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, College of Agriculture, Gwalior (Madhya Pradesh).

The present chapter deals with a brief description of methods fallowed by materials used the period of investigation.

Experimental site:-

The experiment was conducted on 578.6 m^2 area having fairly uniform topography with gental slop and adequate drainage. Soil of experimental field was alluvial and sandy clay loam in texture.

Location and climate:-

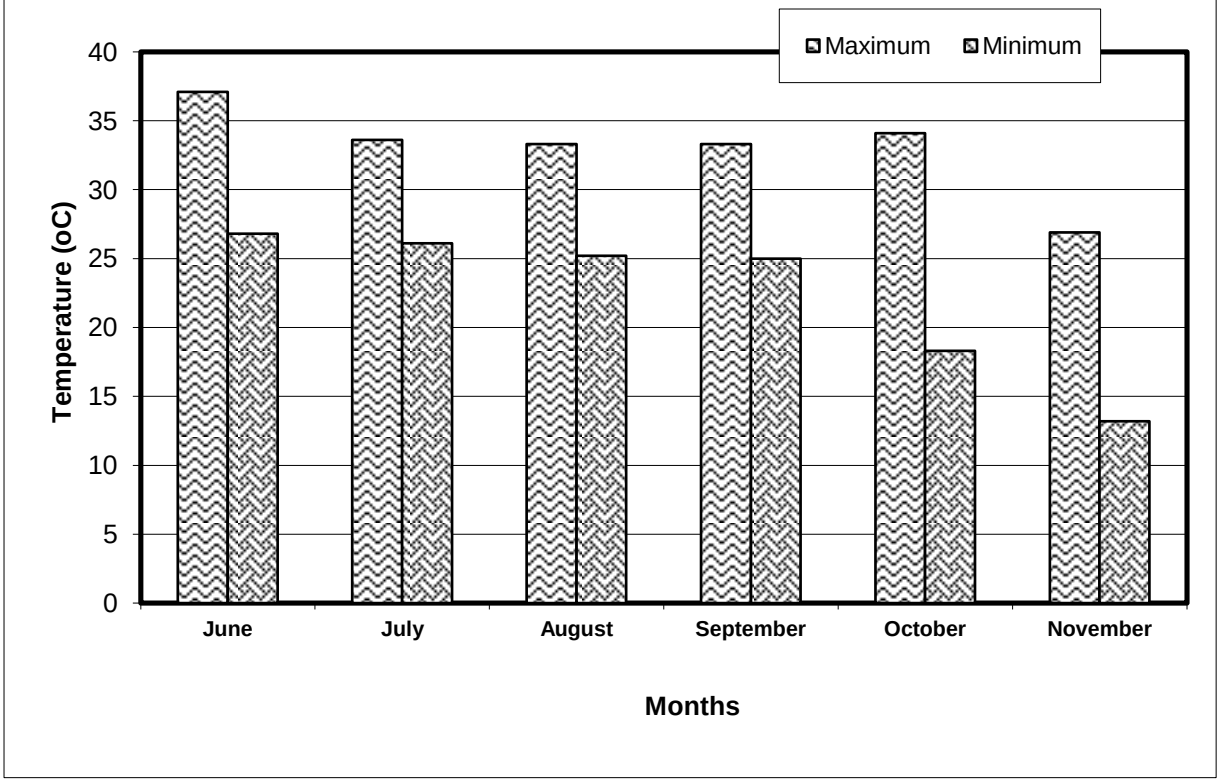
Gwalior is situated in gird zone at the latitude of 26^0 13' North and longitude 76^0 14' East with altitude of 211.52 meters from mean sea level. In Madhya Pradesh, this region comes under semi arid sub tropical climate with extreme whether condition having not and dry summer and cold winter. Generally monsoon set during the last week of June. Annual rainfall ranges from 7000 to 800 mm, most of which falls during last June to middle of September.

During cropping season, the mean monthly maximum 37.1 C^0 and minimum 13.2 ^0C temperature were recorded during investigation period. Monsoon rainfall 843.6 mm was also recorded during cropping season.

Table 3.1: Meteorological data during crop season

June-November 2011	Average Temperature (^0C)		Relative Humidity (%)		Rainfall (mm)
	Maximum	Minimum	Maximum	Minimum	
June	37.1	26.8	74.7	54.4	181.6
July	33.6	26.1	84.6	69.4	304.6
August	33.3	25.2	90.1	71.7	190.6
September	33.3	25.0	84.9	64.3	166.8
October	34.1	18.3	77.3	34.4	000.0
November	26.9	13.2	86.3	34.9	000.0

Fig.3.1 Meteorological data (Temperature 0C) During the experimental year (2011)



Experimental detail:-

The experimental was laid out in randomized block design with four replications. Each replication accommodated six treatments. All the treatment was randomized separately in each replication.

Fig. 3.2- Layout plan in illustrated.

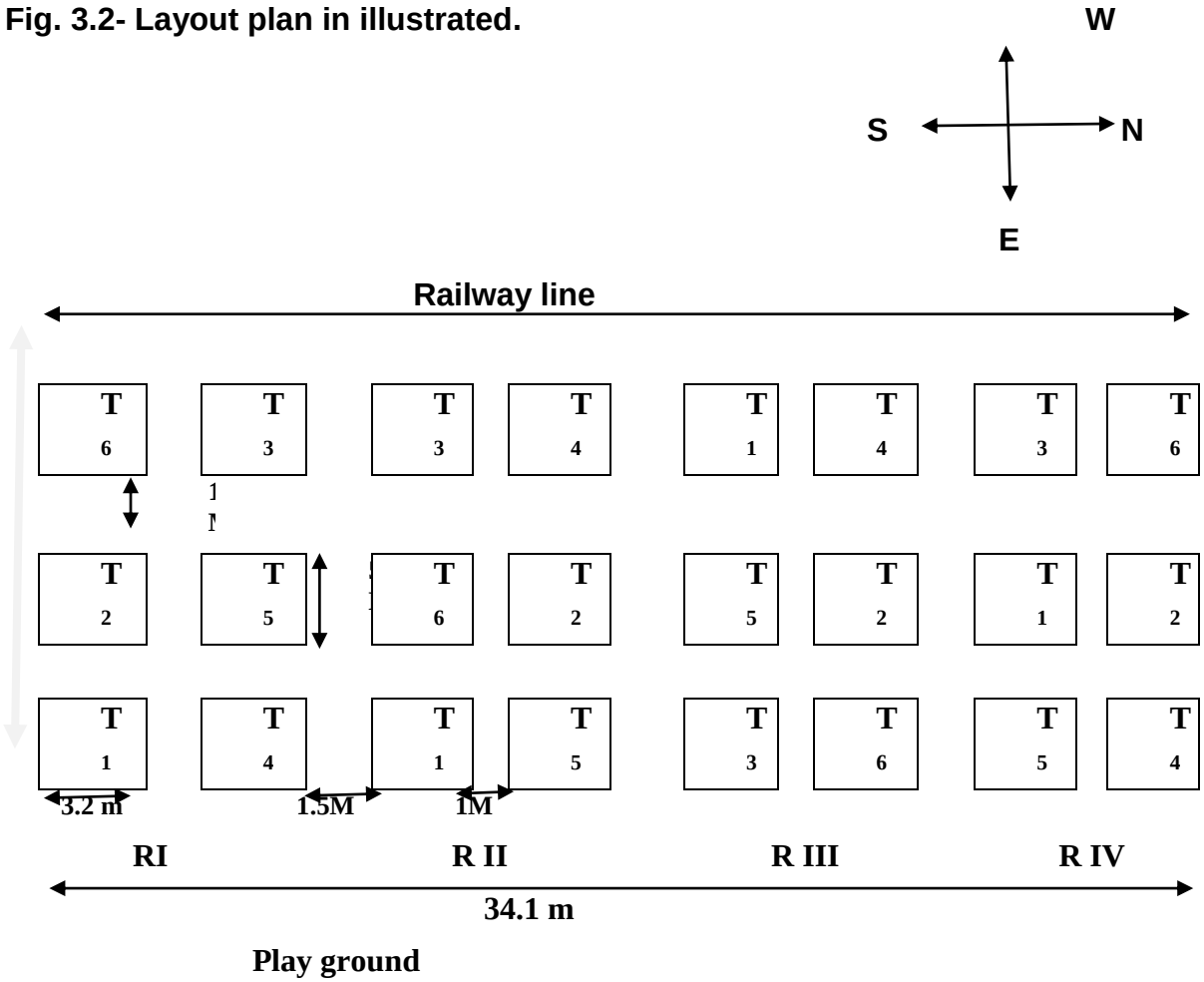


Table 3.2 Cropping history of the experimental field

1.	Design of experiment	R.B.D.
2.	Number of replication	04
3.	Number of treatment	06
4.	Number of total plot	24
5.	Gross plot size	5.0x3.2 m^2
6.	Net plot size	4.0x2.5 m^2
7.	Distance	Row to row 30 cm, Plant to plant 5 cm
8.	Date of sowing	08.07.2011
9.	Variety	JS – 95-60
10.	Seed rate	100 kg/ha
11.	Sowing method	Line sowing
12.	Fertilizer dose	$N:P_2O_5:K_2O$ :: 20:80:20 (kg/ha)
13.	Date of harvesting	

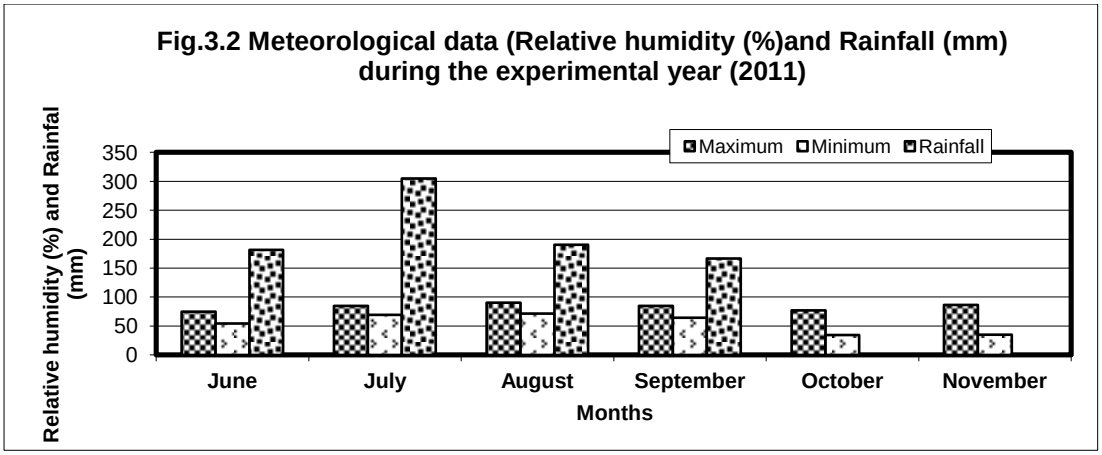


Fig.3.2 Meteorological data (Relative humidity (%)and Rainfall (mm) during the experimental year (2011)

Table 3.3 Details of treatment

S. No.	Treatment	Symbols used
1.	Pendimithalin (PE) @ 1 kg/ha	T_1
2.	Pendimithalin (PE) @2 kg/ha	T_2
3.	Chlorimuron-ethyl (PoE) @ 9 g/ha	T_3
4.	Chlorimuron-ethyl (PoE) @ 18 g/ha	T_4
5.	Weed free	T_5
6.	Weedy check	T_6

Application of fertilizer:- 20 kg N, 80 kg P_2O_5 and 20 kg K_2O per hectare were applied as urea, super phosphate and muraite of potash at the time of sowing.

Seed rate and sowing:- The soybean (c.v. JS – 95-60) was sown @ 100 kg/ha by manual labor in about 3 cm deep furrows already applied with chemical fertilizer. The seeds were converted with soil to level the opened furrows. Row to row and plant to plant distances were maintained.

Soil sampling and analysis

The represented soil samples (0 – 15 cm) from each plot were collected before sowing and after harvesting the crop with the help of soil auger. Each sample was air dried and sieved through 2 mm sieve. The prepared samples were used for the following determinations by standard methods.

Chemical analysis

1. pH

The soil pH was determined by using glass electrodes pH meter in 1:2 soil water suspensions (Piper 1967).

2. Electrical conductivity (EC) (dS/m)

The supernatant liquid of the soil water suspension formerly used for pH determination was used for the determination of electrical conductivity by sol bridge conductivity meter.

3. Organic carbon

Organic carbon was estimated by the Walkley and Black (1934) method. In this method organic matter in the soil is oxidized with a mixture of potassium dichromate ($K_2Cr_2O_7$) and concentrated H_2SO_4 utilizing the heat of dilution of H_2SO_4. Unused $K_2Cr_2O_7$ is back titrated with ferrous ammonium sulphate.

4. Determination of available Nitrogen:

Available nitrogen was determined by the alkaline permanganate method (Subbiah and Asija, 1956).

In this method, 5 g of soil was taken in a digestion tube and little water added. Now add 20 ml. of 0.32% $KMnO_4$ solution to the sample was added and fit the tube in the distillation unit. Add 20 ml of 2.5% NaOH solution through the distyl-em-dosing pump. Pipette out 20 ml. of 2.5% of boric acid in a conical flask and clip the receiving end of the distyl-em in it. Distil ammonia gas from the tube and collect in the received acid. Now add 5 drops of mixed indicator and titrate with 0.02N H_2SO_4. Blank correction (without soil) is to be made for final calculations. The results were expressed in kg/ha.

5. Determination of available phosphorus:

Available phosphorus in the soil was determined calorimetrically by Olsen's method (Olsen *et al.* 1954).

Extraction:-

2.5 g of the soil sample was shaken with 50 ml of 0.5M $NaHCO_3$ (adjusted to pH 8.5) as an extractant together with 1g of Draco G-60 (free from soluble phosphorus) for 30 minutes in 100 ml, conical flask on mechanical shaker and then filtered through filter paper.

Development of colour:-

5 ml of the colorless filtrate was taken in 25 ml volumetric flask for determination and then 5 ml of ammonium molybdate hydrochloric acid solution was added. The contents were diluted to about 10 ml with distilled water, shaken and then 1 ml of working solution of stannous chloride was added to develop blue colour and diluted to the mark, and shaken thoroughly. The colour intensity was measured in photo-electric colorimeter at 660 nm wavelength. The amount of available phosphorus was calculated as P and the results were expressed in kg/ha.

6. Determination of available potassium:-

Available potassium in the soil was determined by flame photometer (Jackson, 1967).

5.0g of soil was shaken with 25ml of neutral normal ammonium acetate solution as an extractant in 100 ml conical flask for 5 minutes and then filtered through filter paper. The amount of available potassium was calculated as K and the result were in kg/ha.

Enumeration of *Rhizobia:*

Rhizobia in soil were enumerated by most probable number (MPN) method (Alexder, 1965).

Plant analysis

Plant sample were collected and dried in oven at 60^0 C Dried sample were grounded in an electric grinder. These samples were used for the analysis of NPK.

1. Determination of nitrogen

Nitrogen in plant sample was determined by micro-kjendal method (Chopra and Kanwar).

Digestion process: In this process 0.5 g of plant sample was transferred to the digestion tube and 10 ml of concentrated sulphuric acid and 2 g of digestion activator (salt mixture) to the sample was added. Loaded the digestion tubes in to the digester and the digestion block heated. At the end of digestion process the sample turned to colorless or light green colour.

Distillation process: During distillation, the ammonium radicals are converted to ammonia under excess alkali condition after neutralizing the acid in the digested sample with 40% alkali NaOH on heating. In DISTYl-EM the digested samples are heated by passing steam and the ammonia librated due to the addition of 40% NaOH is dissolved in 4% boric acid. The acid consisting of ammonia is taken for titration.

Titration process: Titrate the solution boric and mixed indicated containing. The distilled off ammonia with the standardized H_2SO_4. Determine the titration value of a blank solution of boric acid and mixed indicator

.

$$\% N = \frac{(S - B) \text{ x Normility of } H2SO4 \text{ x } 14 \text{ X} 100}{\text{Sample weight (g) x } 100}$$

2. Determination of Phosphorus and Potassium

Phosphorus was determined by Spectrophotomer at 470 wave length and potassium was determined by flame photometer.

One gram oven dried plant sample was taken taken and digested in 100 ml conical flask with 10 ml of di acid mixture (2:5) consisting of chemically pure concentrate perchloric acid and nitric acid respectively and digested material was filtered through filter paper (Whatman No. 44) in 100 ml volumetric flask and filtrate was diluted to mark. This was used for estimation of P and K.

Table 3.4: Salient physic-chemical characteristics of the experimental field

S. No.	Soil properties	Value
1.	pH	7.80
2.	EC (dS/m)	0.16
3.	Organic carbon (%)	0.42
4.	Available nitrogen (kg/ha)	198.6
5.	Available phosphorus (kg/ha)	13.2
6.	Available potassium (kg/ha)	331.7
7.	Textural class	Sandy clay loam
8.	Sand (%)	57.8
9.	Silt (%)	20.5
10.	Clay (%)	21.5
11.	Number of *Rhizobiun* bacteria (10^3/g soil)	9.450

Statically analysis:

The data recorded were statically analyzed in Randomized Block design according to analysis of variance for judging the effect of different treatment on various attributes of soybean. The skeletons of analysis of variable are presented in table 3.5.

Table: 3.5 Skeleton of analysis of variance.

Source of variance	DF	SS	MSS	F cal.	F tab
Replication	3				
Treatment	5				
Error	15				
Total	**23**				

The ‘F’ test was used for testing the significant effect of various treatments.

CHAPTER-IV
EXPERIMENTAL FINDINGS

This chapter deal with the result obtained during the course of investigation to find out the **"Effect of Pendamethalin and Chlorimuron ethyl on nodulation, N_2 fixation, NPK uptake and yield of Soybean (*Glycine max L.*) and its residual effect on microbial count".** The results obtained from different studies are interested and presented in the following paragraphs.

Symbiotic trail of soybean

Different symbiotic trails of soybean were recorded to characterize the nodulation and atmospheric nitrogen fixation by this nodulation at 50% flowering stage.

Nodule number: Nodule number was recorded at 60 DAS (table 4.1).The maximum number of nodules per plant recorded at 60 DAS ranges between 18.0 – 35.75 nodules/plant. Maximum being under T_6 (Weed free) 35.75 Nodules/plant and minimum recorded being under T2 (Pendimithalin (PE) @2 kg/ha) 18.00 Nodules/plant

Nodule dry weight: Nodule dry weight/plant (Table 4.1) was observed in the range from 25.25 to 46.25 mg/plant at 60 DAS. Maximum nodules dry weight was recorded under weed free (T_5) treatment (46.25 mg/plant) significantly superior over all other treatment. Application of Chlorimuron-ethyl (PoE) @ 9 g/ha was found to superior over treatment applied all herbicide. Among different doses of herbicides, Chlorimuron-ethyl (PoE) @ 9 g/ha was found to be better. Higher dose of these treatment i.e. 18 g/ha did not show any significant increase in nodule weight per plant.

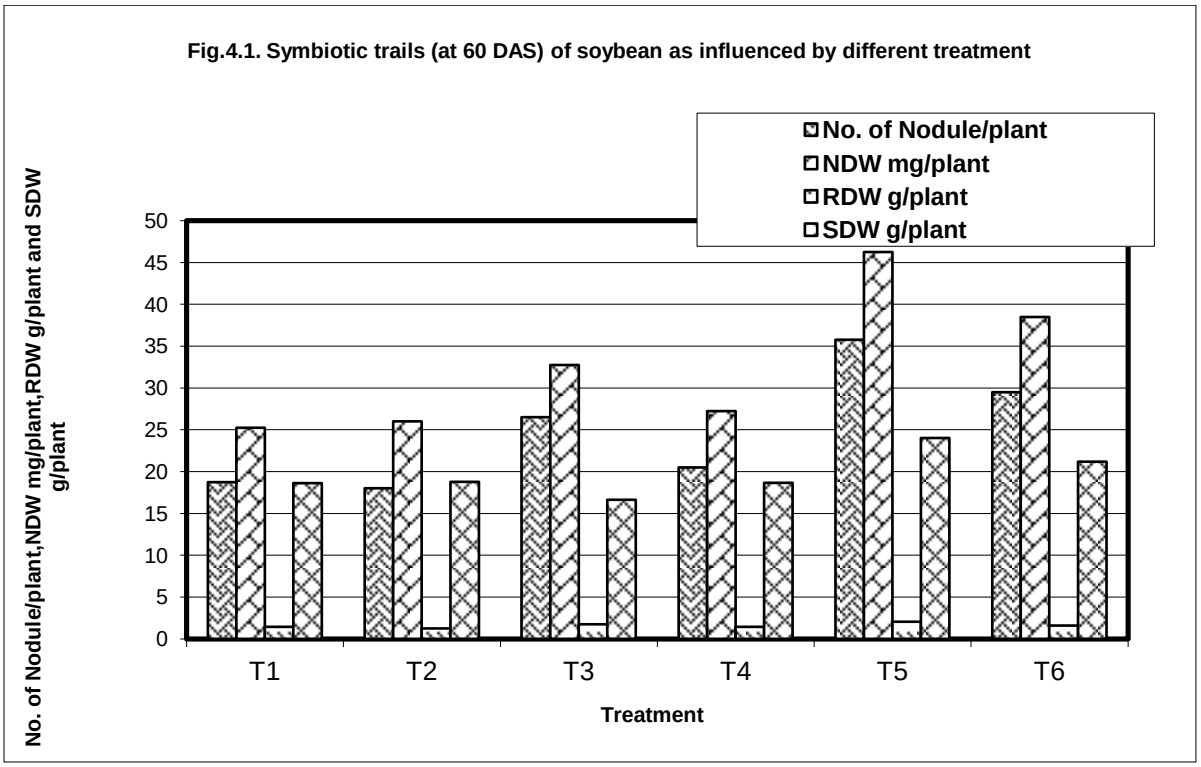
Root dry weight: Root dry weight g/plant (Table 4.1) was observed in the range from 1.225 to 2.050 g/plant at 60 DAS. Maximum root dry weight (2.050 g/plant)

was recorded under weed free (T_5) treatment which was significantly superior over all other treatment.

Shoot dry weight: Shoot dry weight per plant was also recorded 60DAS (Table-4.1), which range from 16.65 to 24.00 g/plant 60DAS. Weed free and weedy check gave maximum shoot dry weight as compared to remaining treatment. Maximum shoot dry weight (24.00 g/plant) was recorded under weed free (T_5) treatment which was significantly higher over all other treatment. Minimum shoot dry weight (16.65 g/plant) was observed under Chlorimuron-ethyl (PoE) @ 9 g/ha (T_3) treatment.

Table 4.1: Symbiotic trails (at 60 DAS) of soybean as influenced by different treatment

Tr. No.	Treatment detail	No. of Nodule/ plant	NDW mg/plant	RDW g/plant	SDW g/plant
T_1	Pendimithalin (PE) @ 1 kg/ha	18.75	25.25	1.45	18.62
T_2	Pendimithalin (PE) @2 kg/ha	18.00	26.00	1.22	18.77
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	26.50	32.75	1.72	16.65
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	20.50	27.25	1.45	18.65
T_5	Weed free	35.75	46.25	2.05	24.00
T_6	Weedy check	29.50	38.50	1.57	21.17
SE(±)		**2.14**	**2.07**	**0.17**	**1.64**
CD (5%)		**6.459**	**6.24**	**0.51**	**4.94**



N_2 fixation in soybean at 60 DAS:

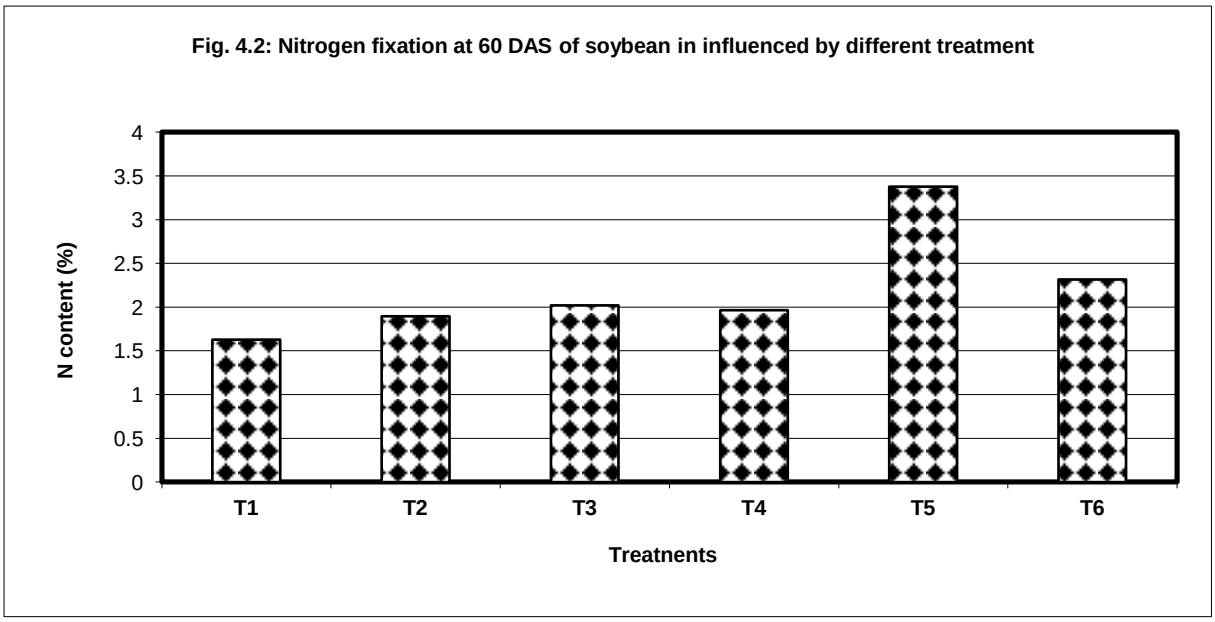
Nitrogen fixation in soybean crop was maximum (Table 4.2) during nodulation stage 55-60 das) which was range between 1.63 to 3.38 %. A significant increase in N_2 content was found with different treatment and the magnitude of the increased in N2 –content due to various treatments was 2.5 to 36.2 % over the control.

It is evident from the result that application of weed free gave higher N_2 content in plant compared to other herbicide dose.

Maximum N_2 content in plant at 60 DAS was found in the treatment applied weed free (T_5) which was significantly higher in all treatment but close to the treatment of weedy check, where as minimum under weed free (3.381 %)

Table 4.2: Nitrogen fixation at 60 DAS of soybean in influenced by different treatment

Tr. No.	Treatment detail	N content (%)
T_1	Pendimithalin (PE) @ 1 kg/ha	1.63
T_2	Pendimithalin (PE) @2 kg/ha	1.89
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	2.02
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	1.96
T_5	Weed free	3.38
T_6	Weedy check	2.31
SE(±)		**1.33**
CD (5%)		**4.01**



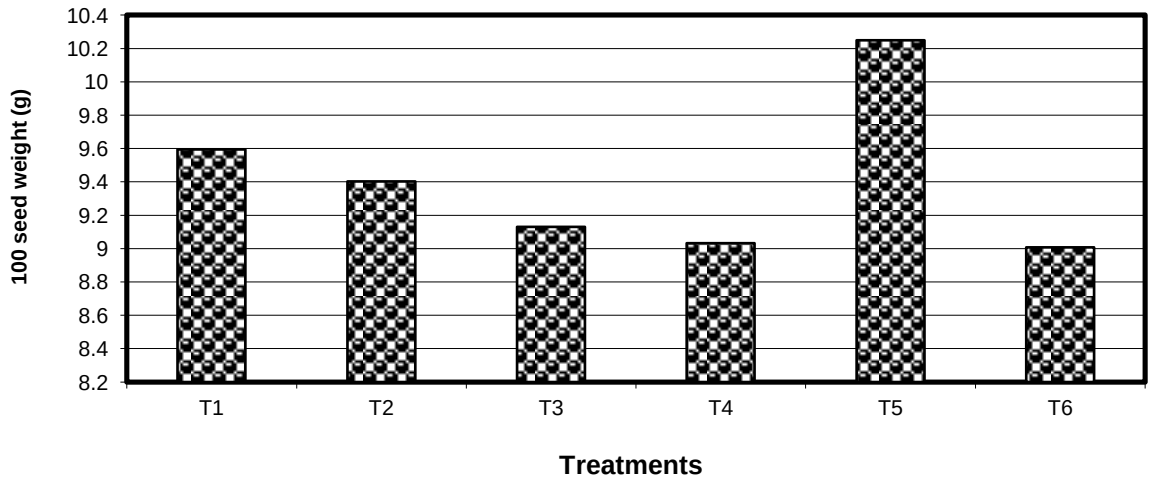
Seed weigh (g)

It is an impotent yield attributing characters which determine the seed and quality of grain produced. It is inferred from the data given in Table 4.9, that the different herbicide applied as pre-emergence or post emergence did not showed any significant difference from weedy check. Seed weight was varied between 9.00 to 10.2 gram. Maximum seed weight was recorded with T_5 (weed free) and minimum seed weight recorded T_6 (weedy check).

Table 4.3: 100 seed weight (g) of soybean influenced by the different treatment

Tr. No.	Treatment detail	100 seed weight (g)
T_1	Pendimithalin (PE) @ 1 kg/ha	9.59
T_2	Pendimithalin (PE) @2 kg/ha	9.40
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	9.13
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	9.03
T_5	Weed free	10.25
T_6	Weedy check	9.00
SE(±)		**0.31**
CD (5%)		**9.00**

Fig. 4.3: 100 seed weight (g) of soybean influenced by the different treatment



Seed yield (Kg/ha)

It is clearly from the (Table – 4.4) that there was significant response in seed yield due to different treatment as compared to the control. Seed yield varied from 1168 to 2246 kg/ha under different treatment.

Maximum seed yield (2246 kg/ha) was noted under the treatment weed free (T_5) but it followed by the application of Pendimithalin (PE) @2 kg/ha. Whereas, minimum yield was obtained in treatment weedy check.

It is clear from the result that cultural practices for herbicide also affect the seed yield in significant way treatment weed free produced significantly higher seed yield over all the treatment.

Straw yield (Kg/ha)

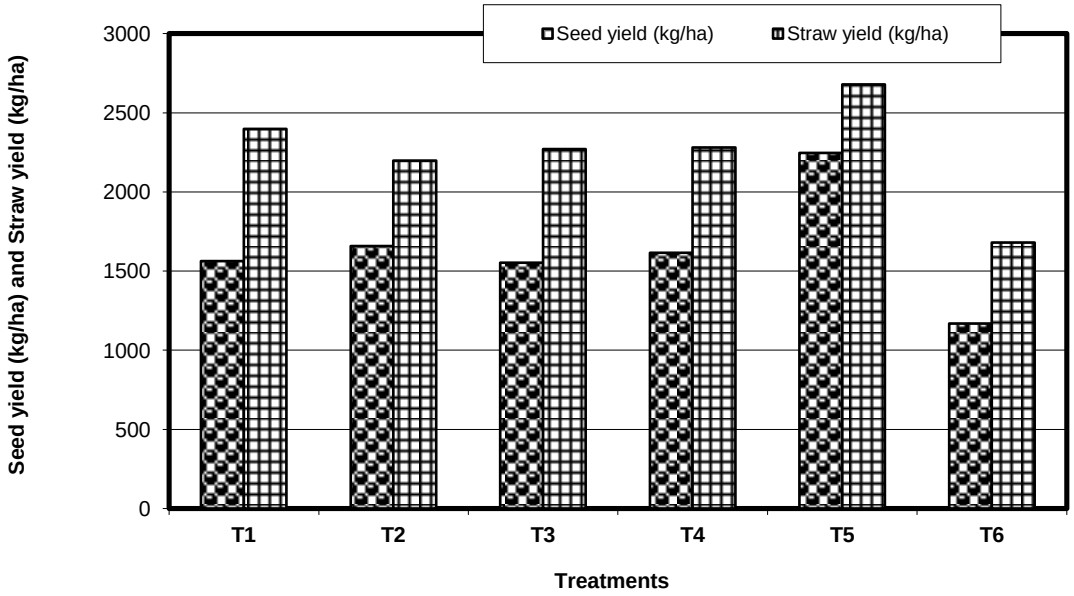
It is clearly evident from the Table – 4.9. The straw yield was significantly affected by various treatments. Straw yield varied from 1681 to 2679.5 kg/ha.

Straw yield increased significantly higher weed free over the herbicides applied. However application of herbicides were similar and numerically at par with each other. Highest straw yield in weed free (2679.5 kg/ha)

Table 4.4: Effect of different treatment on seed and straw yield (kg/ha) of soybean

Tr. No.	Treatment detail	Seed yield (kg/ha)	Straw yield (kg/ha)
T_1	Pendimithalin (PE) @ 1 kg/ha	1563.75	2398.25
T_2	Pendimithalin (PE) @2 kg/ha	1658.00	2198.00
sT_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	1553.50	2270.75
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	1616.50	2280.00
T_5	Weed free	2246.00	2679.50
T_6	Weedy check	1168.00	1681.00
SE(±)		**75.42**	**110.22**
CD (5%)		**227.36**	**332.24**

Fig.4.4: Effect of different treatment on seed and straw yield (kg/ha) of soybean



Nutrient (NPK) content in seed:

Nitrogen content in seed

The NPK content in seed presented in (Table 4.5). The N content (%) in seed influenced by the different treatment is presented in table. Data revealed that different source of herbicides applied at different stage .

Nitrogen content in seed was found to the tune of 6.09 – 6.79 % in different treatment and maximum N content (6.79%) being recorded under the weed free (T_5) and minimum N content (6.08%) weedy check.

It is clear from the result that the application of Pendimithalin (PE) @ 1 kg/ha and Chlorimuron-ethyl (PoE) @ 9 g/ha recorded significantly higher N content in seed as compared to other herbicides.

Phosphorus content in seed

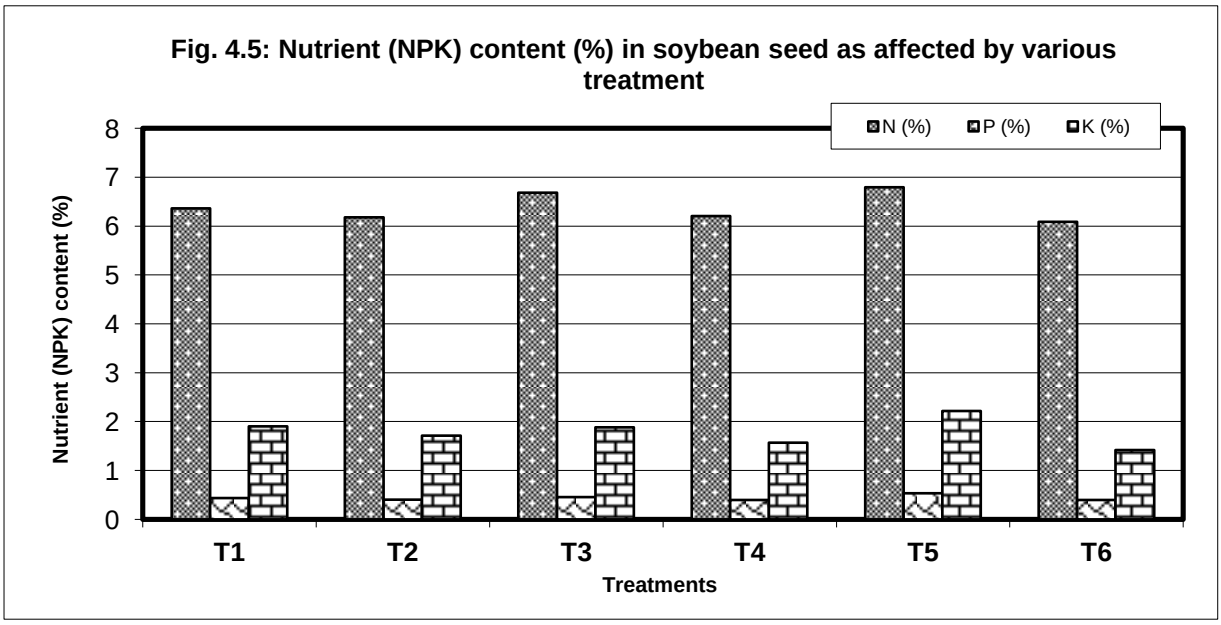
Phosphorus content in seed (Table – 4.5) was in the range of 0.39 – 0.53 %. Maximum P content (0.53%) observed in weed free (T_5) and minimum P content (0.39%) weedy check.

Potassium content in seed

The data presented in (Table - 4.5) indicate a significant increase in K content in the different method of control in soybean crop. Potassium content in seed was found in the range of 1.41 – 2.21 %. Maximum K content (2.21%) was recorded in weeds free treatment and minimum K content (1.41%) in weedy check.

Table 4.5: Nutrient (NPK) content (%) in soybean seed as affected by various treatment

Tr. No.	Treatment detail	N (%)	P (%)	K (%)
T_1	Pendimithalin (PE) @ 1 kg/ha	6.36	0.43	1.90
T_2	Pendimithalin (PE) @2 kg/ha	6.18	0.40	1.71
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	6.68	0.45	1.88
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	6.21	0.39	1.56
T_5	Weed free	6.79	0.53	2.21
T_6	Weedy check	6.08	0.39	1.41
SE(±)		**0.04**	**0.02**	**0.07**
CD (5%)		**0.14**	**0.06**	**0.21**



Nutrient (NPK) content in straw

Nitrogen content in straw

The data on N content in straw in (Table – 4.6) revealed that N content differ significantly with different treatment than the control expect Pendimithalin (PE) @ 1 kg/ha and Chlorimuron-ethyl (PoE) @ 9 g/ha (T_1 and T_3) treatment in which marginally higher content were recorded and were statistically super control or weedy check. Nitrogen content in straw was found to the tune of 1.37 – 1.1.93 % under the different treatment. Maximum N content was recorded with the treatment weed free (T_5) and minimum N content in straw was noted under weedy check (T_6).

Phosphorus content in straw

The P content in straw was influenced by different treatment which was presented in table – 4.6, data revealed that higher dose of Pendimithalin (PE) @2 kg/ha and Chlorimuron-ethyl (PoE) @ 18 g/ha gave lower P content in straw.

Maximum P content in soybean straw noticed in weed free (T_5) and minimum P content in weedy check(T_6).

Potassium content in straw

Potassium content in straw (table – 4.6) was in the range of 1.19 – 1.75 %. Maximum K content (1.75%) was observed in weed free (T5) treatment where as minimum K content was in weedy check (T_6) treatment. It was evident from the results that K content in straw did not showed any significant difference in application of herbicide as compared to control.

Table 4.6: Nutrient (NPK) content (%) in soybean straw as affected by various treatment

Tr. No.	Treatment detail	N (%)	P (%)	K (%)
T_1	Pendimithalin (PE) @ 1 kg/ha	1.61	0.16	1.41
T_2	Pendimithalin (PE) @2 kg/ha	1.46	0.14	1.26
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	1.59	0.18	1.29

T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	1.53	0.15	1.19
T_5	Weed free	1.93	0.22	1.75
T_6	Weedy check	1.37	0.13	1.24
SE(±)		**0.04**	**0.01**	**0.03**
CD (5%)		**0.13**	**0.03**	**0.10**

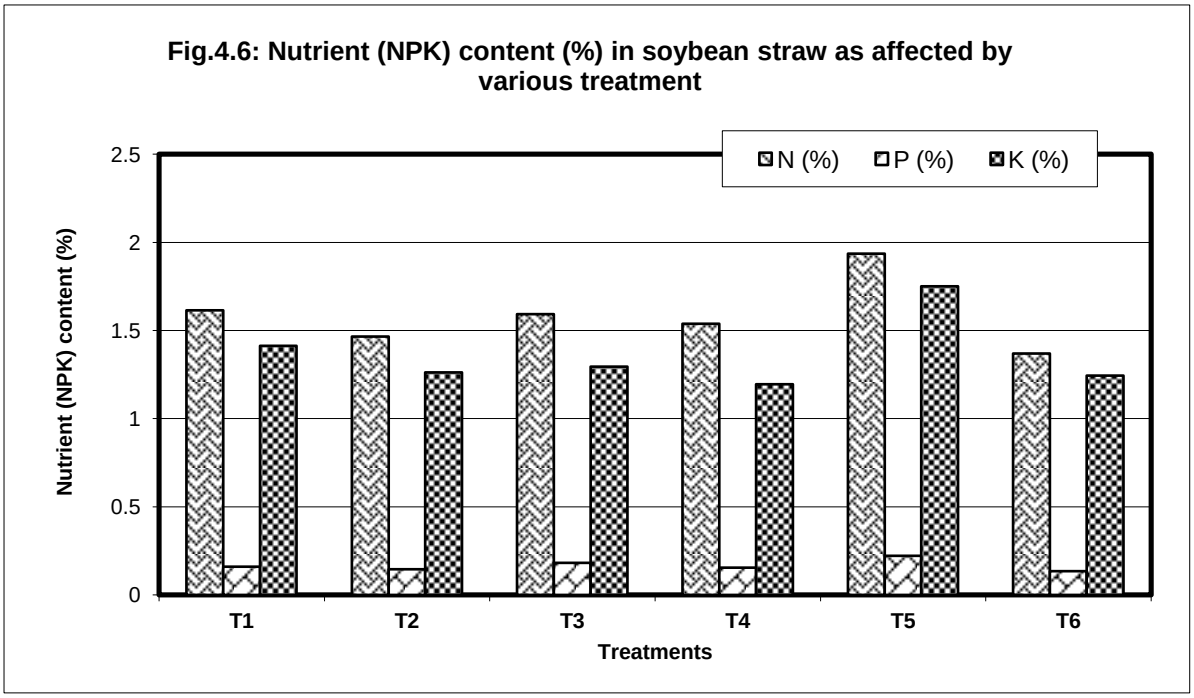


Fig.4.6: Nutrient (NPK) content (%) in soybean straw as affected by various treatment

Uptake of Nitrogen (kg/ha) by seed, straw and total soybean

The data on uptake of nitrogen in seed, straw and its total as affected by different treatment are presented in table 4.12. Nitrogen uptake by soybean and straw showed as significantly increase in different treatment as compared to control.

Uptake of nitrogen by soybean seed and straw were to the tune of 74.19 – 149.3 kg/ha, respectively.

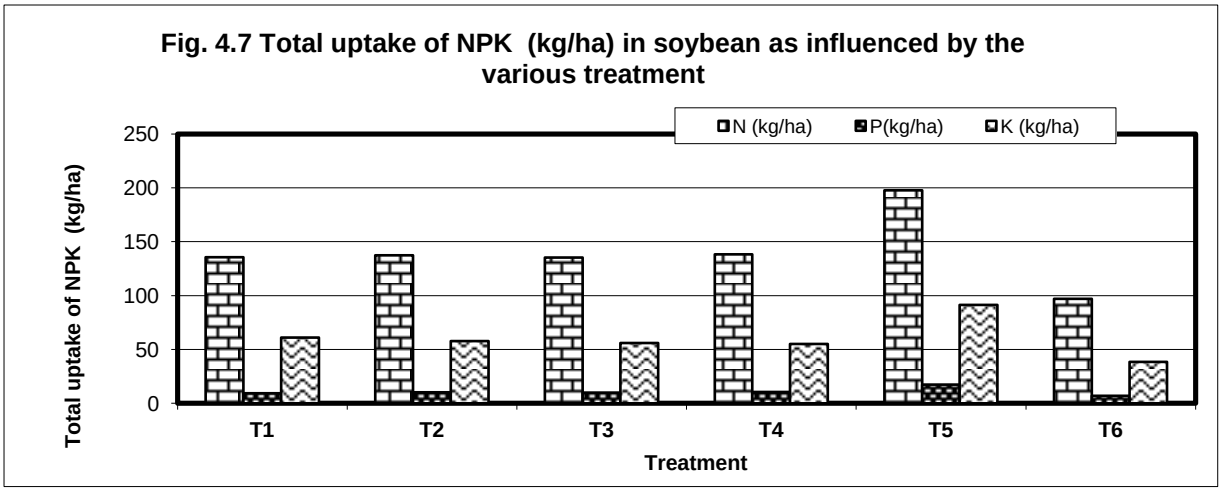
Total (seed + straw) uptake of N varied from 97.09 -197.57 kg/ha in different treatment. Maximum total uptake recorded under treatment weed free (T_5) which due to high content of N seed as well as their straw yield.

In general, the uptake of nitrogen by seed, straw and total followed the pattern obtained in yield and nitrogen content.

Table 4.7: Nitrogen uptake (kg/ha) in seed, straw and total of soybean as influenced by the various treatment

Tr. No.	Treatment detail	Seed	Straw	Total
T_1	Pendimithalin (PE) @ 1 kg/ha	100.12	35.53	135.66
T_2	Pendimithalin (PE) @2 kg/ha	105.56	31.91	137.48
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	100.46	34.97	135.43
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	101.91	36.33	138.25
T_5	Weed free	149.30	48.27	197.57
T_6	Weedy check	74.19	22.90	97.09
SE(±)		**1.51**	**1.62**	
CD (5%)		**4.57**	**4.89**	

Fig. 4.7 Total uptake of NPK (kg/ha) in soybean as influenced by the various treatment



Uptake of Phosphorus (kg/ha) by seed, straw and total soybean

The phosphorus uptake by soybean plant at harvest (seed, straw and total) as influenced by the different treatment is documented in (Table 4.8). The data on P uptake by seed indicated a significant in different treatment, compared to the control maximum P-content by seed (11.73 kg/ha) was recorded in T_5 (weed free) and was significantly higher over all the remaining treatment.

Data on phosphorus uptake by straw also showed a significant increased due to different as compared to control. Maximum P uptake (11.73 kg/ha.) was noticed under the treatment weed free and followed by the other treatment.

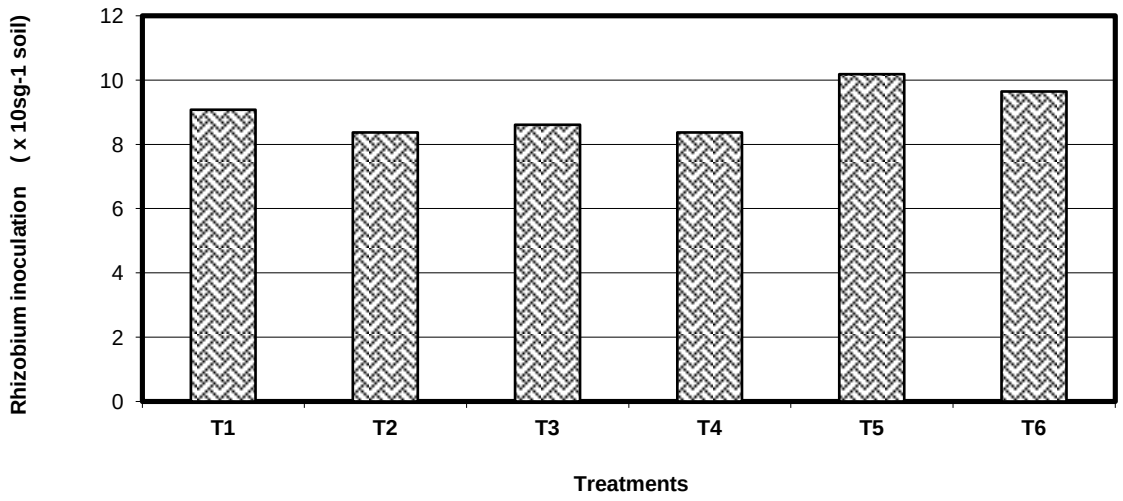
The total uptake of p by soybean also exhibited as significant increase on account of different treatment total uptake was found in the range 7.01 – 17.22 kg/ha and magnitude of increase in P uptake ranged from 32.1 – 170 % by the different treatment. The highest P uptake (17.22 kg/ha) was observed under weed free (T_5) which was significantly higher over the rest of treatment which was due to higher contents in seed and straw as well as their yield.

Controlling the weeds by the herbicide application also showed a significant by the phosphorus as compared to the treatment weedy check.

Table 4.8: Phosphorus uptake (kg/ha) in seed, straw and total of soybean as influenced by the various treatment

Tr. No.	Treatment detail	Seed	Straw	Total
T_1	Pendimithalin (PE) @ 1 kg/ha	6.86	3.50	9.36
T_2	Pendimithalin (PE) @2 kg/ha	6.82	3.53	10.35
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	6.16	3.77	9.94
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	6.95	3.61	10.47
T_5	Weed free	11.73	5.48	17.22
T_6	Weedy check	4.79	2.21	7.01
SE(±)		**0.33**	**0.28**	
CD (5%)		**1.02**	**0.84**	

Fig.4.8: Microbial population in the soil as affected by various herbicides in soybean crop



Uptake of Potassium (kg/ha) by seed, straw and total soybean

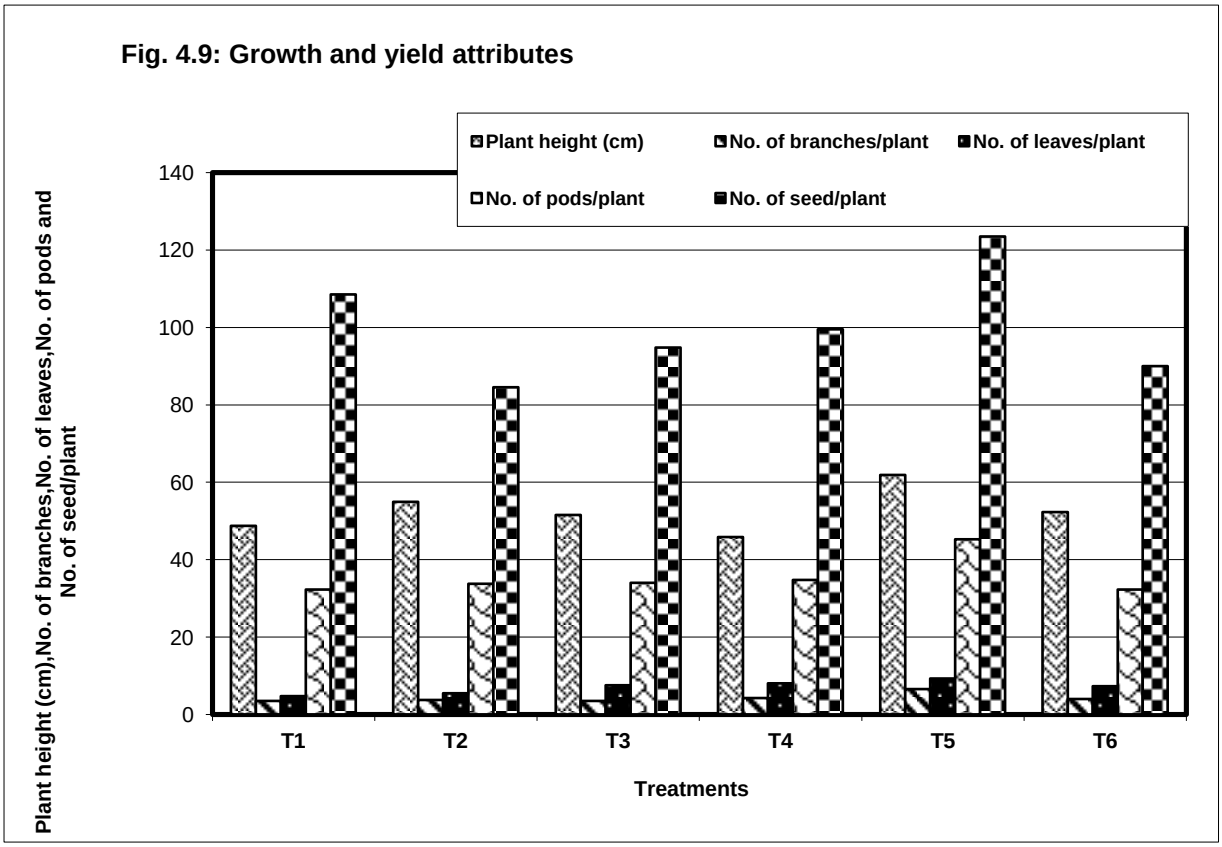
The data on K uptake by soybean at harvest (seed, straw and total) was influenced by the different treatment, which was presented in Table 4.9. The potassium uptake by seed indicated a significantly increase due to all the treatment over the control. Maximum K uptake (48.7 kg/ha) was noticed under the treatment weed free and minimum uptake was noted in treatment weedy check (17.24 kg/ha).

Total uptake of K by soybean crop was found in range of 38.42 – 91.18 kg/ha and the magnitude of increase in K uptake range from 31.12 – 136.56 % by the different treatment. The highest total K uptake was noticed under weed free (T_5) which was significantly higher over all the treatment.

Significantly higher total K uptake was noticed in weed free treatment over all the other treatments.

Table 4.9: Potassium uptake (kg/ha) in seed, straw and total of soybean as influenced by the various treatment:

Tr. No.	Treatment detail	Seed	Straw	Total
T_1	Pendimithalin (PE) @ 1 kg/ha	29.89	31.14	61.04
T_2	Pendimithalin (PE) @2 kg/ha	28.06	29.81	57.87
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	28.29	27.69	55.99
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	25.70	29.31	55.12
T_5	Weed free	48.70	42.37	91.18
T_6	Weedy check	17.24	21.17	38.42
SE(±)		**0.87**	**1.55**	
CD (5%)		**2.63**	**4.69**	



Microbial population:-

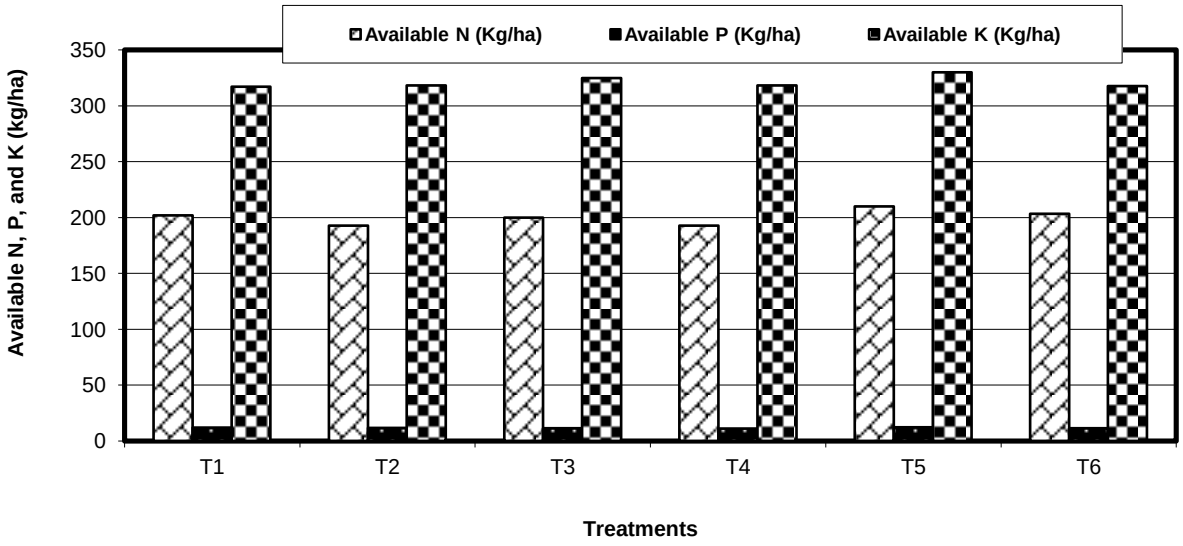
Data on the population of the Rhizobium bacteria in the soil initial and after harvest were found in range of 9.45 and 8.37 to 9.82(**x $10^5 g^{-1}$ soil**) are presented in (Table 4.10) . Data indicated the application of herbicide affected the population of Rhizobia, as compare to the initial population but some of the treatment. Like T_1, T_5, and T_6 enhanced the Rhizobial population after the soybean crop.

It is a clear from data that the application of weed free enhanced the microbial population in the soil as compared to herbicide application.

Table 4.10: Microbial population in the soil as affected by various herbicides after soybean crop.

Tr. No.	**Treatment detail**	**Rhizobium inoculation (x $10^5 g^{-1}$ soil)**
T_1	Pendimithalin (PE) @ 1 kg/ha	9.07
T_2	Pendimithalin (PE) @2 kg/ha	8.37
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	8.61
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	8.37
T_5	Weed free	10.18
T_6	Weedy check	9.65
SE(±)		**0.24**
CD (5%)		**0.74**

Fig. 4.10 Available N, P, and K status of the soil (Post harvest)



Growth and yield attributes:

Table 4.11: Growth and yield attributes:

Tr. No.	Treatment detail	Plant height (cm)	No. of branches/plant	No. of leaves /plant	No. of pods/ plant	No. of seed/plant
T_1	Pendimithalin (PE) @ 1 kg/ha	48.675	3.500	4.750	32.250	108.50
T_2	Pendimithalin (PE) @2 kg/ha	54.900	3.750	5.500	33.750	84.500
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	51.550	3.500	7.500	34.000	94.750
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	45.775	4.250	8.000	34.750	99.500
T_5	Weed free	61.850	6.500	9.250	45.250	123.50
T_6	Weedy check	52.275	4.000	7.250	32.250	90.000

SE(±)		**3.774**	**0.711**	**1.304**	**3.336**	**9.236**
CD (5%)		**11.376**	**2.143**	**3.932**	**10.05**	**27.84**

Residual fertility status of the soil after harvesting soybean crop

pH : It is apparent from the (Table 4.5) that the plant nutrient applied through inorganic fertilizer and application of different herbicides either pre or post emergence and containing the weeds through culture practices or even weedy check did not showed any change in soil pH .

Electrical conductivity (dS/m): A data on electrical conductivity (Table 4.1) in various treatments was more or less mane in different treatment electrical conductivity also showed anon significant difference in various treatments.

Organic Carbon: Data revealed organic carbon recorded after crop was non significant and the difference gain in (Table 4.12), numerical only.

Table 4.12: Initial and post harvest soil properties

Tr. No.	Treatment detail	pH	EC (dS/m)	OC %
	Initial status of field	7.80	0.16	0.42
T_1	Pendimithalin (PE) @ 1 kg/ha	7.81	0.141	0.41
T_2	Pendimithalin (PE) @2 kg/ha	7.87	0.139	0.42
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	7.81	0.132	0.42
T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	7.82	0.145	0.41
T_5	Weed free	7.89	0.137	0.42
T_6	Weedy check	7.86	0.142	0.42
SE(±)				
CD (5%)				

Available N, P, and K status of the soil (Post harvest)

Data on available N,P, and K status (Table 4.13) in the soil after harvest of soybean crop reveled that available nitrogen status of soil showed a significant positive change due to the different treatment but phosphorus and potassium content did not showed only significant change in harvest stage. The significant change in nitrogen content was only due to cultural operation, which causes aeration and more N_2 fixation in the soil.

Available Nitrogen (Kg/ha): Available N content was found in range from initial (198.6 Kg/ha) and after harvesting (192.6– 209.9 Kg/ha) in different treatment. Maximum N status was observed under the treatment weed free (T_5) treatment whereas minimum under the treatment Pendimithalin (PE) @2 kg/ha.

Available phosphorus (Kg/ha): The data recorded on the status of available phosphorus was found in the range initial (13.2 Kg/ha) and after harvesting (11.1 – 12.2 kg/ha) and highest being under weed free (T_5) but it was numerically higher to other treatment.

Available Potassium (Kg/ha): Data on available potassium status of the soil initial and after harvest was found in range of (331.7 kg/ha) and after harvesting (318.20 – 330.00 Kg/ha) under different treatment. Maximum available potassium left in the soil noted under the treatment weed free (T_5). Data revealed that the change in available value was only numerical.

Table 4.13 Available N, P, and K status of the soil (Post harvest)

Tr. No.	Treatment detail	**Available N (Kg/ha)**	**Available P (Kg/ha)**	**Available K (Kg/ha)**
T_1	Pendimithalin (PE) @ 1 kg/ha	201.87	11.84	317.15
T_2	Pendimithalin (PE) @2 kg/ha	192.67	11.58	318.37
T_3	Chlorimuron-ethyl (PoE) @ 9 g/ha	199.82	11.32	325.00

T_4	Chlorimuron-ethyl (PoE) @ 18 g/ha	192.85	11.12	318.20
T_5	Weed free	209.92	12.26	330.00
T_6	Weedy check	203.35	11.23	317.82
SE(±)		**1.37**	**0.20**	**2.69**
CD (5%)		**4.15**	**0.62**	**8.13**
	Initial	**198.6**	**13.2**	**331.7**

Balance of nutrient in soil:-

Nitrogen Balance: The data presented in (Table 4.14) revealed that N- status of the soil after soybean crop was increased (118.1 – 188.8 Kg/ha) with different treatment are compared to the initial level of available N (198.6 kg/ha) but its magnitude was among 124 %.

The application of different sources and doses of herbicides has a marked impact on the nitrogen fixation and its balance in soil. The nitrogen gain (+) by the different treatment was found in the tune of (+) 118.8 to (+) 188.8Kg/ha (Table 4.14) maximum nitrogen gain (+) was noticed under the treatment of weed free (T_5) where as minimum under Loss (-) Pendimithalin (PE) @2 kg/ha or gain (+) of nitrogen over initial status of the range between (-)5.8 to (-) 6.0 and (+) 1.0 to (+) 11.6 kg/ha.

Phosphorus Balance: Data (Table 4.15) on P balance in soil revealed that P- status of the soil was decreased with different treatment as compared to initial level of available phosphorus (13.2 kg/ha). Phosphorus status in after harvest was found in the range of 11.127 to 12.225 kg/ha under different treatments.

In term of loss and gain, all treatment showed loss in the case of available phosphorus. Data on loss (-) or gain (+) of phosphorus status indicated that phosphorus was decreased which was (-) 6.2To (-) 1.0kg/ha and (+) 0To (+) 0 Kg/ha over the initial status of the phosphorus however actual phosphorus balance data showed positive trends, indicates gain in P – status but actually status was reduced

but the quantum of loss phosphorus was (-) 6.2 To (-) 1.0 kg/ha less and (+) no To(+) no kg/ha more which indicates that fixation of phosphorus in the soil.

Potassium Balance: Balance sheet of potassium (Table 4.19) showed depletion (-) or up (+) in different treatment after soybean crops compared to the initial level.

It is cleared from the data that the application of different herbicides did not affect the potassium balance. The potassium balance was affected by the growing soybean crop and its higher requirement, while initial status of potassium (331.7 kg/ha) which was in medium to high range data on depletion showed that the K was reduced from (-) 14.6 to (-) 1.7 kg/ha and build up (+) was to the tune of (+) 0 to (+) 0 kg/ha. Maximum loss (-) 14.6 Kg/ha was recorded under treatment Pendimithalin (PE) @ 1 kg/ha and minimum (-) under the application of weed free.

CHAPTER - V
DISCUSSION

The result obtained the investigation of field experiment have been discussed in this chapter with the support of appropriate work done by scientist in the past.

Nodulation study:

Nodule number per plant in soybean was found to increase with the age of the plant and maximum number of nodule was recorded at weed free treatment.

The application of different herbicide enhanced the nodule number and nodule dry weight with per plant probably due to increase in Rhizobium population in the weed free treatment. Maximum nodulation was noted under weed treatment. This might be due to the fact that weed free plot help in root enlargement sand prolification which resulted in more sites of infection and thereby increased nodulation in soybean. These finding are in agreement with the finding of Billore *et al.* (2001).

Nodule dry weight:

Maximum nodule dry weight was found in weed free while minimum was in weedy check treatment. It is negetively related to the number of nodules per plant (Billore *et al*. 2001)

Root dry weight:

Maximum development of soybean root was observed up to 55 DAS. Maximum root dry weight was recorded weed free treatment.

Shoot dry weight:

Shoot dry weight of soybean crop was to increase with the growth of the plant. Maximum shoot dry weight was in weed free treatment and minimum was weedy check. Weed free treatment resulted vigorous growth and height of the plant compared to less weed free. It may be due to lees availability of the foods to the soybean plant. Anikwe *et a*l. (2003) reported reduse dry weight by application of herbicides.

N2-fixation at 55 DAS:

Maximum N2-fixation noted weed feed treatment and minimum weedy check. It might be due to soybean crop, which had appropriate recovery period for soil biota and proper use of herbicide could be less destructive and Rhizobium which improved biological activity in the soil (Gupta and Roget, 2005).

Yield attributes and yield:

Yield can be considered to be the final expression of physiological and metabolic activities of the plant and is governed by various factors. Weed crop competition may reduce the soybean yield. Hundred seed weight increased significantly over weedy check. In general100 seed weight also increaded by all weed control treatment.

The seed as well as straw yield significantly increased by weed free. (Hert *et al.* 1995) Increase in seed and straw yield and shaded residue at harvest may be due to significantly improvement in growth and yield attributing parameters, improved aeration due to weed control less or no-competition of crop weed in the field.

Nutrient content and uptake:

It is evident from the results that N, P, K content and as well as uptake in the seed and straw were significantly affected by weed content treatment. Application of weed free treatment increased the control of nutrient and uptake in seed and straw over herbicide application and weedy check. The might be due to proper management of weeds and more availability of nutrient for soybean crop. Kurchania *et a*l. (2001) Jat *et al*. (2002) also reported similar results Panner Selvam *et al*. (2000) reported increased the availability of P in soil.

Rhizobium count:

It is evident from the result that Rhizobium cells per g of soil were reduced as than the initial level but some of these nitrogen fixing bacteria. This showed positive impact of herbicides on soil biological functions. This evidence suggested that herbicides can enhance the biological nitrogen fixation with Rhizobum inoculation. Gupta and Roget, (2005) reported similar results.

Residual nutrient availability:

Application of Chlorimuron ethyl and pendamethalin as well as cultural operations did not showed any change in soil pH, EC, and organic carbon content. Among available nitrogen, phosphorus and potassium content, only nitrogen increased after harvest in the soil might be due to the higher nitrogen mineralization. Gupta and Roget (2005) reported that change to the composition and activity of soil micro flora resulting the benefits through accelerated N mineralization and reduced disease incidence.

Balance sheet of nutrient:

It is evident from the data of balance sheet of nitrogen, phosphorus, potassium and was found to be increased or gain after harvest of that crop whenever phosphorus was decreased in all the treatment as compared to their actual balance to apparent balance.

CHAPTER – VI

SUMMARY, CONCLUSION & SUGGESTIONS FOR FURTHER WORK

Soybean (*Glycine max* L. Merrrill) is an important *Kharif* oilseed legume crop of Madhya Pradesh, which is recognized as “Soya State” of India, with approximately 75% share in National area in production of soybean in the country. Today, soybean occupies a vital place in agriculture and oil economy of India, contributes more than 10 % of the foreign exchange earnings for India in agricultural sector through exports.

Soybean is also known for its rich nutritional value, as it contains 20-22 per cent cholesterol free oil, 23% carbohydrates, 38-42% protein, besides sufficient amount of minerals and vitamins.

Although, soybean has become quite popular amongst the cultivations of India, its average yield is about 1000 kg/ha, against its potential yield of 2500-3000 kg/ha. Amongst various factors responsible for the low yield, weeds have been considered to be the most injurious. The crop is sown with the onset of monsoon, as a rain fed crop, the weeds emerge simultaneously with the crop and grow vigorously, which ultimately subdue its yield potential.

Generally, weeds are controlled by cultural, mechanical or chemical treatment either alone or in combination of more than one method. Herbicide use has now become on essential practices. If herbicide applications remain available practices in sustainable farming system, evolution of herbicide affects, especially from repeated and long term use, is essential to ensure optimum functioning of soil biota, nutrient availability and plant growth. Considering above facts the present investigation entitled, **“Effect of Pendamethalin and Chlorimuron ethyl on nodulation, N_2 fixation, NPK uptake and yield of Soybean (*Glycine max L.*) and its residual effect on microbial count”** was carried out at the Research farm, College of Agriculture, Gwalior (M.P.) during the *Kharif* season of 2011.

The salient finding of the research work is summarized below;

- Application of Chlorimuron-ethyl (PoE) @ 9g/ha and weed free treatment improve the N_2 fixation at 60 DAS. The highest nodulation was noted under weed free treatment Seed yield, straw yield and 100 seed weight was increased in weed free treatment comparatively application of herbicide plots.
- Use of herbicide did not show any improvement in yield and N_2 fixation as compared to weed free treatment.
- Maximum seed and straw yield was noted under weed free treatment (hand weeding) as compared to weedy check.
- N2 fixation at 55 DAS not affected by the application of herbicide applied recommended dose.
- NPK content and uptake significantly increased in seed and straw in weed free treatment.
- Application of herbicide had no impact on pH, EC, and organic carbon content of the soil.
- After post harvest of the crop, status of available nitrogen increased as compared to initial status.

CONCLUSION:

A field study was carried out on **"Effect of Pendamethalin and Chlorimuron-ethyl on nodulation, N_2 fixation, NPK uptake and yield of Soybean (*Glycine max L.*) and its residual effect on microbial count"** indicated related that highest seed yield was under weed free treatment which produced 112.4% higher yield than weedy check. Without application of herbicide treatments (weed free) improved N2 fixation, and NPK uptake by the soybean crop, however weed free operations improved microbial count. Treatment T_1 (Pendimithalin (PE) @ 1 kg/ha) and T_3 (Chlorimuron-ethyl (PoE) @ 9 g/ha) is supirear T_2 (Pendimithalin (PE) @2 kg/ha)and T_4 (Chlorimuron-ethyl (PoE) @ 18 g/ha) treatment. Lower dose of herbicides are showed good performance as compared to high dose of herbicides with regards to yield and microbial count.

Treatment weed free improved N_2- fixation NPK uptake by the soybean crop and also improved microbial count. Application of Pendimithalin (PE) @2 kg/ha and Chlorimuron-ethyl (PoE) @ 9 g/ha improve Nodulation growth and yield attributes.

Suggestion for further work:

This is preliminary information on the effect of different herbicides on soil biological activity and its related parameters. For evaluation of this work and its impact on above parameters. It should be continuing.

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ABSTRACT

Part - I

1.	Title of the thesis	:	"Effect Pendimithalin and cholorimuron ethyl on nodulation, N2 fixation, NPK uptake and yield of soybean (*Glycine max* L.) and its residual effect on microbial count"
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: **“Effect Pendimithalin and cholorimuron ethyl on nodulation, N2 fixation, NPK uptake and yield of soybean (*Glycine max* L.) and its residual effect on microbial count”**

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ABSTRACT

Part – II

Soybean [*Glycine max* (L.) Merrill]is an important *kharif* oilseed legume crop of the Madhya Pradesh, which is recognized as “ Soya State” of India, with approximately 75 % share in National area and production of soybean in the country.

Generally weeds are controlled by cultural or mechanical or chemical treatment either alone or in combination of more than one method. Herbicide use has now become an essential practice. If herbicide application remain a viable practice in sustainable farming system, evaluation of herbicide affects, a especially from repeated and long term use, is essential to ensure option functioning of soil biota, nutrient availability and plant growth. Considering above facts the present investigation entitled, “Effect Pendimithalin and cholorimuron ethyl on nodulation, N2 fixation, NPK uptake and yield of soybean (*Glycine max* L.) and its residual effect on microbial count” was carried out at the research Farm, College of Agriculture, Gwalior (M.P.) during the ***kharif*** season of 2011.

The experiment was laid out in the randomized block design (RBD) with six treatment having four replications. Treatment comprised of Pendimithalin (PE) @ 1 kg/ha, Pendimithalin (PE) @2 kg/ha, Chlorimuron-ethyl (PoE) @ 9 g/ha, Chlorimuron-ethyl (PoE) @ 18 g/ha,weed free and weedy check, soybean JS 9560 was grown by adopting recommended pakage of practices except weed control measures, which were applied as per treatment.

Result showed that nodule number and its dry weight, root dry weight ,Shoot dry weight at 60 DAS was increased with growth growth of the plant .

Maximum seed yield of soybean was noted under weed free treatment and weed free as compared to weedy check which was 112.3 and 125.3 % higher respectively. Nitrogen content in soil after harvest of the soybean crop was also found to increased as compared to their initial status in Rhizobium inoculated treatments even low levels of chlorimuron ethyl and pandamithalin herbicide. N_2-fixation at 60 DAS highest in weed free treatment. Application of herbicides had no impact on pH, EC and organic carbon content of the soil. After harvest of the crop, status of available nitrogen, phosphorus and potassium were increased as compared to initial level in most of the treatment. Weed free treatment superior herbicid treatment.

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