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CHEMICAL AND STATICAL STUDY OF CHLORINATED PESTICIDES AND BIOFERTILIZER ON GROWTH PARAMETERS OF CUMIN CULTIVATION FROM DIFFERENT VILLAGES OF NAGAUR DISTRICT IN RAJSTHAN (INDIA)

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Abstract:

In this Study, eight villages of Nagaur distrct were selected to see the effect of chlorinated pesticide and biofertilizer on growth parameters cumin cultivation. One field is selected from each village and make four plots in that field, in which P-1 plot is treated as normal, P-2 plot is treated with pesticide, P-3 plot is treated with biofertilizer and P-4 plot is treated with both pesticide and biofertilizer. In cumin seed treatment, Ampligo is used as insecticide and PSB as biofertilizer, Tubeconozole as fungicide in soil treatment and Trichoderma viridi as biofertilizer. Comparative study of growth parameters of cumin after 35 days and 70 days after sowing of crop. The growth parameters of the plot in which pesticide and biofertilizer were used were found to be good. Pesticides and biofertilizers were not sprayed in any plot for 35 days and sprayed after 35 days. Biofertilizer and pesticides were not sprayed in P-1 plot of cumin, which yielded less seed germination percentage and in P-4 plot both biofertilizer and pesticide were used together, which yielded higher seed germination percentage

Keywords: Cumin, Seed Germinations, Growth Parameters, Seed Treatments, Soil Treatment, Ampligo, Tubeconozole, PSB, Trichoderma viride, Chemical Spray, and Seed variety GC-4 etc.

1. Introduction:

Cumin is an important spice crop, having good medicinal properties. It is grown predominately in the arid and semi-arid regions of the world. This paper deals with the comprehensive study of nutritional value, cultivation practices, botany morphology, and the varietal characteristics of different varieties of cumin crop. The current scenario and status, of area, production, and productivity in India during 2010 to 2019 has been reviewed to identify the various factors affecting cumin productivity and production [1]. It was found that the area and production of cumin in India increased by 60% and 28%

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respectively. While cumin export has been increased by 464% in terms of quantity between 2010 and 2019, there is huge potential to increase productivity by managing all the constraints. People usually have something common in their meal. One such is cumin which is used in different dishes [2]. However, the cumin that gives a good flavour to your dishes may also endanger your life. This is revealed in a report released by the Department of Agriculture and Cooperation, Government of India. According to the report, cumin produced in Rajasthan is highly poisonous due to high usage of pesticides and other agrochemicals. The research report by All India Network Project on Pesticide Residues is awaited. According to a report published by a media house, pesticides content in cumin seeds is many times more than the minimum acceptable level. Cumin cannot be grown in foggy and dewy atmosphere [3]. Thus farmers in the Marwar region of Rajasthan produce it at large scale. The average cumin production per hectare in Rajasthan is much higher than other parts of the country. The total arable land area in which cumin is harvested in India is around 429 thousand hectares. Rajasthan alone accounts for 169 thousand hectares, around 40 percent of the country. It shows the importance of the state in cumin production in the country [4]. The cumin of Rajasthan is sold in Unjha and many other mandis along Khari Baoli in Delhi. Then, this cumin reaches your plate through many smaller mandis in the country. A universal approach to using medicinal plants and natural compounds in cosmetics and pharmacological industries, and consequently by authorities, national industries, in addition to people's attention to use medicinal and aromatic plants especially Cuminum cyminum L., indicate the necessary need of wide basic science and applications research in this field. Our purpose is to evaluate cultivation date and priming effects on quantity and quality performance of cumin [5]. Cumin is one of the most important spice seed crops of India and state of Rajasthan dominates in production of cumin in India. Being a cash crop, there is a great demand of organic cumin. Organic cumin in Rajasthan represent a very negligible part of our total cumin production. The one of the constraints in increasing the area under cumin production is lake of suitable organic production practices for different agro climate regions [6]. The present investigation was aimed to study the influence of certain bioagent, organic manures bio pesticides on diseases control and yield of cumin in southern Rajasthan. Organic farming is gaining gradual momentum across the world. In India about 5,28,171 hectare area is under organic farming with 69,256 numbers of certified organic farms [7]. Among various spice seeds crop cultivated in India, the cumin is important for both internal consumption and exports. The crop is generally grown as rabi crop in cool and dry climate Cumin is grown extensively in Rajasthan, Gujarat, and Uttarpradesh. Rajasthan and Gujarat together accounts for more than 90 percent of total area under cumin grown in india. Cumin is cultivated in India in 5,14,000 ha. With annual production of 79,000 tonnes [8]. The aromatic flavours in the cumin seed is due to presence of volatile oil. It is chief ingredient in mixed spices and curry powders used for flavouring different beverages [9]. Alternaria blight caused by Alternaria burncii, Alternaria blight, Powdery mildew and Wilt diseases cause severe yield losses in cumin and have been identified as major production constraints. Wilt of cumin is an important soil borne disease while Alternaria

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blight and Powdery mildew are important foliar diseases that affect the crop. The diseases cause serious yield losses under favourable weather conditions which may as high as 83 percent under congenial weather condition [10]. Alternaria blight, Powdery mildew and wilt disease are most important diseases of cumin in India. Till now, the diseases are managed mostly through the use of pesticides. The indiscriminate use of pesticides causes environmental and ecological hazards. Botanical pesticides have received attention of the growers because these are considered as less toxic and environmentally safe [11]. The antimicrobial property of some plant extracts under in vitro and in vivo have been reported. We investigated on the effect of plant extracts Neem oil, Azedirachtin against Alternaria burncii, Erysiphe poligony and Fusarium oxysporum in field condition Chemical management of all three diseases is un economical and environmentally hazardous. Therefore, there is a need to look for non-hazardous and eco-friendly control measures for plant diseases management [12]. In this context an investigation was planned to evaluate the efficacy of organic module against Alternaria burncii Erysiphe polygony and Fusariun oxysporum pathogens causing Alternaria blight, Powdery mildew and wilt diseases in cumin respectively. The efficacy of six different modules were tested against Alternaria blight, Powdery mildew & and wilt diseases in cumin at Dryland Farming Research. This research has conducted in medicinal plant research field of Shahed University located at the beginning of Tehran-Qom Highway at the agricultural year of 2014-2015 [13]. The experiment performed as a two-treatment factorial in a randomized complete block design with three replications. The first treatment was priming at two level include without priming (control) and hydro priming for eight hours, and the second treatment was three cultivation date including 4 February, 19 February, and 5 March [14]. Variance analysis of results showed that the effect of priming and cultivation date on seeds number per plant, harvest index and active ingredients like alpha pinene, beta pinene, o-cymene, limonene, p-cymene, linalool, alpha-terpineol, and cumin aldehyde, were significant at the statistical level of 5%. But it has not significant effect on the weight of 1000 seeds and biological performance [15]. In addition, the highest number of the seeds per plant, seed performance, beta pinene, limonene, p-cymene, and linalool was for hydro priming at cultivation date of 4 February [16]. However, it has not significant effect on the number of umbels per plant, the weight of 1000 seeds and biological performance. In addition, the highest number of seeds per plant, seed performance, beta pinene, limonene, p-cymene, and linalool observed for hydro priming treatment at cultivation date of 4 February [17]. But this treatment resulted in fewer amounts of active ingredients like o-cymene and alpha Terpineol. In this experiment, delay in cultivation date resulted in a decrease of biological performance and weight of 1000 seeds. Generally, results of the effect of the cultivation date and priming treatment interaction showed that using hydro priming results a non-significant increasing in some of the active ingredients at cultivation date of 4 February in comparison with control [18].

Both food ingredients and nutritional supplements are an important source of bionutrient. In addition to its use as food additive and for flavour, it has many important medicinal properties and used to cure several diseases that form a necessary part of

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Indian system of medicine called Ayurveda [19]. Although cumin is an economic cash crop, limited efforts have been made for varietal development. Indian cumin is a traditional spice and is found almost in every household. Spice cumin (Cuminum cyminum) is considered as one of the important seed spices used extensively in India and other countries for flavouring dishes due to its strong and heavy flavour. It is considered to be the oldest spice known since biblical times [20]. Though cumin is a native of Egypt, but now India is the largest producer and consumer of cumin seed in the world. Cumin is an ancient spice having a history of over 5000 years and referred as native to the historical Levant region and northern Egypt. Cumin belonging to Apiaceae family and genus Cuminum is a small and slender annual herb which grows to a height of about 45 cm with many branches and linear dark green leaves [21]. Flowers of this spice crop are small white or pink and are borne in small compound umbels. The fruit of cumin is a lateral fusiform or ovoid achene 4-5 mm long, containing a single seed [22]. Cumin seeds contain 2.5-4.0% volatile oil, aldehydes, culminal which impute to its medicinal properties. It is carminative, diuretic, stimulant, digestive, tonic, appetizer, stomachic, astringent and useful in curing diarrhoea and dyspepsia and is a highly nutritive spice having various elements which add on to its nutritional factors and increases its value much. The element in amount/100 g present in cumin contains energy 1567 KJ (375 Kcal), carbohydrates 44.24 g, sugars 2.25 g, dietary fibres 10.5 g, fat 22.7 g and protein 17.81 g [23]. This spice crop is subjected to many pathogens causing disease which negatively influences the yield. Recently, reported the status of cumin diseases on farmer's fields in cumin-growing districts of Rajasthan and Gujarat. The major diseases of cumin observed by them on farmer's field were wilt, blight and powdery mildew in moderate to severe form. Cumin is grown in the arid and semi-arid regions of the world [24]. This is commercially cultivated in Iran, India, Turkey, China, Morocco, Indonesia and Japan. In India, cumin is mainly cultivated in dry area of the states of Rajasthan and Gujarat which accounts for 99% of area and production due to favourable agro-climatic conditions. The plant attains a height of 30-40 cm, thrives well in tropical regions because of the fibrous root, and also growth period coincides with winter and spring rainfall that provides drought tolerance ability [25].

2. Literature Review:

Cumin is one of the important major seed spice crops, considered to be a remunerative cash crop mainly grown in the western part of the country particularly in Rajasthan and Gujarat occupying about 507850 hectares area with annual production of about 314220 tonnes. Front line demonstrations on cumin consisting two important varieties (GC-4 and RZ-209) with the scientific interventions viz., line sowing, seed treatment (Bavistin 2.5 g kg-1 seed and Trichoderma viride @ 4 g kg-1 seed, to protect from soil born fungi) and application of recommended doses of nutrients (40 kg ha1 each N and P) for balanced nutrition with appropriate plant protection schedule (two sprays of malathion @ 0.2%, two sprays of dithane M-45 @ 0.2% and one spray of karathane @ 0.1%) were carried out at four farmers' fields in villages viz., Sindhion Ki Dhani, Baldon Ki Dhani, Rampura and Bagawas in Pali district of Rajasthan during Rabi season of 2012-

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13 [26]. Study revealed that overall 39.82 % yield was increased over farmers' traditional practice under the FLD of improved variety with the technological interventions with the yield of 625 kg ha-1. The overall average extension gap 177.50 kg ha-1 of with technology gap (375 kg ha-1) and technology index (37.50) was recorded. The overall average additional returns of Rs. 23075 ha-1 was obtained under the demonstration fields with the maximum additional returns of Rs. 26000 ha-1 obtained in F4 field due to higher grain yield. Both the varieties with recommended package of practices can be recommended in western Rajasthan for successful cultivation of cumin for fulfilling the demand of domestic and export markets. Cumin (Cuminum cyminum L.) is an important spice crop, belongs to the Apiaceae (Umbelliferous) family, Cumin seeds are known for their aroma and medicinal use [27]. It is seasonal crop grown in Rabi season. It is grown as inter crop under both the rainfed and irrigated conditions after the Kharif crops like jowar, green gram, cowpea, and maize. The cumin crop is grown mainly in two states of India viz., Gujarat and Rajasthan. The Rajasthan state covers largest area 6.72 lakh ha under cumin cultivation whereas; Gujarat state has highest production 3.19 MT of cumin crop in the year 2018-19 [28]. Cumin crop is a cash crop and it gives good net returns profit with proper management. Therefore, farmers are interested to cultivate this crop. However, the cumin crop is very sensitive to weather conditions and requires improved agronomic practices and management to get quality seeds and good yield. The cumin is a small bushy plant grown annually. It has thin stem having 3 to 5 cm diameter and height of 20 to 30 cm. It has a throne less branched stem of greenish colour at early stage and greyish colour at maturity [29]. Cumin plant flourishes large number of small pink or white colour flowers at same level with equal length of stalk. The fruit of cumin is similar to Cremo carp grows from lower ovary. The fruits are light brown or greyish in colour and ovate or fusiform in shape. The fruit of cumin is termed as seeds but the real seeds are come out by breaking the fruit wall at the time of germination [30]. Cumin seeds are dry and capsuled shaped and split into two fragments with just one seed having a grooved wall at maturity stage. The seeds are curved lengthwise and brownish in colour similar to other members of Apiaceae family but more resemble to caraway seeds [31]. It has wide range of medicinal properties. Nutritional value and medicinal properties of cumin crop among the seed spices cumin is a high-quality source of various nutrient, vitamins and minerals. Many people around the world do not get enough iron in their daily diet. As a result, iron deficiency is one of the most common nutrient deficiencies, affecting nearly 20% of the world's population and up to 10% of people in the wealthiest nations [32]. Cumin seeds are naturally high in iron, one teaspoon of ground cumin contains 1.4 mg of iron, or 17.5 percent of the RDI (Reference Daily Intake) for adults [33]. It is also a good resource of manganese as per the ratings of the World's Healthiest Foods, which improve the haemoglobin in the human body and for boosting the immune system. It has several medicinal properties, used for treatment of stimulant, carminative, stomachic, astringent and constructive in diarrhoea and dyspepsia [34]. It is also used to treat fever, nausea, vomiting, abdominal discomfort, edoema, and puerperal disorders. Dried cumin seeds are significant in terms of nutritional value and health

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benefits because they contain volatile oil (5-7%), fat (20-24%), protein (9-11%), fibre (10-12%), and free amino acids [35]. Cumin seed oil is used as multifunctional luminescent paints or in topical clothing ointment. It has been used in the treatment of mild digestive disorders as a carminative and eupeptic and astringent in bronco pulmonary disorders and as a cough remedy, as well as an analgesic [36]. Cumin is a good source of minerals too such as copper and zinc, as well as vitamins like B-complex, riboflavin, thiamine, niacin and antioxidant vitamins such as A, E and C [37]. It serves as an active reservoir for a variety of bioactive compounds with therapeutic applications. The shoots of cumin plant are good source of metabolites, fatty acids, phenolic compounds and amino acids. All of these properties reveal the plant's therapeutic potential while also providing valuable information about metabolic responses to salinity stress [38]. Cumin essential oil has high antibacterial activity against Klebsiella pneumoniae in vitro, and cumin aqueous/solvent extract has been shown to restrict the growth of a variety of pathogenic microorganisms [39]. The earlier studies indicate that cumin essential oils have considerable toxicity against various insect pests of stored food, and it can prevent food spoilage, due to the antibacterial and anti-Aspergillus property of this plant [40]. Cumin is a drought-tolerant crop and generally grown in the tropical or subtropical region. The seed emergence starts at 2 to 5°C whereas, optimum temperature required for germination is 20 to 30 °C. The Mediterranean climate is most suitable for its growth. Climate fluctuations play crucial role during growing phase of plant, such as at low temperatures the colour of leaves changes into purple, whereas at higher temperatures the growth period may reduce and early maturity is achieved which results in ultimately low seed yield [41]. At the flowering and fruiting stage high humidity can cause damage to crop due to incidence of diseases such as powdery mildew and blight. The soil condition also plays significant role in productivity of crop. The most suitable soil for cumin cultivation is sandy to loamy soil with proper drainage, adequate aeration and high oxygen availability. The preferred pH range of soil is 6.8 to 8.3 [42]. Cumin seedlings are highly susceptible to salinity. The proper and improved cultivation practices can increase the production and productivity of the crop. It can also save the resources such as seeds, fertilizers, pesticides and insecticides

Cumin is a necessary element of nutrition in human beings and seeds, fruits and flowers are in use for flavour enhancement and now also used as food preservatives [43]. Cumin is an excellent source of iron, manganese, magnesium, calcium, phosphorus and vitamin B1. Other vitamins present in it include thiamine, riboflavin, niacin, vitamin A, C, E, K, and vitamin B6. Cumin contains minerals such as copper, zinc and potassium. It is also rich in protein, amino acids, carbohydrates, dietary fiber and a reasonable amount of fats and fatty acids. It is very low in saturated fats, sodium and cholesterol. Consuming about one teaspoon of cumin daily can help you meet your daily nutrient requirements. This spice cumin is found to be yellow or brown grey with shape elongated and abundant medicinal property. Its seed is found to have carminative, scented, stomachic, cooling and synergistic effect. Its oil is used as multipurpose glowing paint or in appropriate cloth ointment. Its seeds contain certain health benefits

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essential oils such as cumin aldehyde, pyrazines, methoxy secbutyl pyrazine, ethoxy isopropyl pyrazine and methyl pyrazine. Gut motility increases the digestion [44]. Phenolic compounds containing essential oil are found in cumin as cumin aldehyde and para cymene. Cumin aldehyde is an aromatic and is an important constituent oil of eucalyptus myrrh. Cumin aldehyde present in cumin oil possesses anti-inflammatory activity [45]. It is synthesized by the decrease of iso-propyl benzyl chloride and the cumin formulation. It is used effectively in cosmetics and used on large scale commercially in perfumes. It is also reported that it inhibits the fibrillation of alpha synuclein, Parkinson's disease and viral contamination [46]. Medicinal Value of Cumin The health benefits of cumin include its ability to aid in digestion, improve immunity and treat skin disorders, insomnia, respiratory disorders, asthma, bronchitis, anemia, boils and cancer. It promotes digestion and is a rich source of iron. It contains beneficial plant compounds. It may help with diabetes. It may improve blood cholesterol. It may promote weight loss and fat reduction. It may prevent foodborne illnesses. It may help with drug dependence. Its seeds with phytochemicals are found to contain antioxidant, anti-flatulent and carminative property. It is a good source of soluble containing dietary fibre. It is an astringent and aromatic herb which benefits the digestive tract apparatus. It is found to be good remedy for treating mild problems as a carminative, bronco dial tract disarray as an astringent and for cough remedy and as an analgesic [47]. Similar results have been provided where it has been proved that essential oils of cumin seeds are found to have important antibacterial action against K. pneumoniae in vitro. It has been reported that it is used as a scented product in forms of creams lotions, and perfumes. Traditionally it shows and proves that cumin is very effective and powerful as stimulant, carminative and astringent, antiseptic, anti-hypertensive herb, tonic and its therapeutic use has been explained on gastro-intestinal, respiratory disorders and for treating tooth-ache, diarrhea and epilepsy [48]. Cumin is a precious spice crop in India as it is a very important part of Indian cuisines as it adds a very good punch of flavour in it as well as it is used in various medicinal purposes due to presence of volatile oil and aldehydes in it. Cumin covers an area of about seven lakh hectares in India with ample amount of production. This spice is used to flavour in beverage industry and effective pungent taste. The nutritional values show that this spice contains very good amount of protein, enriched carbohydrates, diet fibres and vitamins like ribo-flavin, thiamine and niacin. It is considered to be enriched source of calcium and minerals. There are some negative effects of cumin spice which prove and show the caution when used with therapy drug but found to be very famous and nutrition containing spice in present times [49]. Cumin severely suffers from various fungal diseases which impart negative effect on the yield due to which cumin growers face great loss and it simultaneously leads to national economic loss. So, various attempts are being made to tackle these pathogens by making various chemicals which control their growth, by making pathogen resistant and tolerant varieties and multidisciplinary aspects are being made to improve the production technology of cumin. Though soil organisms are well known for their immense diversity and contributions to maintenance of soil fertility since the time of Darwin, they figured on the global research and management agenda with initiation of

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the United Nations Convention on Biological Diversity (UN-CBD) Programme of Work on Agricultural Biodiversity (PoW) by the end of the twentieth century. The review of the PoW revealed that agricultural practices continue to threaten biodiversity and long-term sustainability of agricultural production itself through (i) conversion of natural habitats to croplands and (ii) loss of regulatory and supporting services supporting cost-effective production of health food. Agricultural development approaches targeting high levels of biodiversity, efficient use of locally available resources and optimization of multiple services/functions (e.g. food/ feed production, climate regulation, resilience and clean water) of agricultural land use started getting more and more attention with researches revealing the unsustainability of conventional high-input agricultural systems [50]. Loss of soil biodiversity is causally linked to unsustainability and, conversely, its enhancement to sustainability of agriculture but the knowledge about this relationship is quite limited Agrochemical centred approaches to raise food production moved. India from the list of food-deficient to food-surplus countries in the world. It is however conclusively established that the agricultural development path adopted in the past is no longer sustainable and needs innovative changes [51]. One such innovation would be to harness the potential of soil organisms in maintaining and enhancing multiple functions of agroecosystems.

3. Study Area-

1) Inana (V-1)
2) Kuchera (V-2)
3) Gaju (V-3)
4) Chhilra (V-4)
5) Balaya (V-5)
6) Parashara (V-6)
7) Silariya (V-7)
8) Dehroli (V-8)

4. Research Methodology-

We used Gujarat Cumin-4 (GC-4) variety in our study area. The combined effect of pre-sowing seed treatment and varieties showed significant effect for growth and seed yield characters of cumin.

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Binomial name - Cuminum cyminum

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Apiales
Family:	Apiaceae
Genus:	Cuminum
Species:	**C. cyminum**

4.1 Seed Details of Used GC-4 Cumin Seed-

Shelf Life	**1 Year**
Variety	GC-4
Seed Class	TFL
Packaging Type Available	Packet
Packaging Size Available	2 kg
Price	Rs 350/kg (2kg-700/kg)
Color	Brown

4.2 Personal Protective apparatus- Gloves, Long Sleeves, Boots & Mask etc.

Tools – These tools were used in soil sampling Khurpi, Auger, Spade, Pen- Paper, Sieve, Plastic Bag, Banner and Board etc.

4.3 Methodology of Seed Treatment in Cumin Plots-

Table 1: Show Readings of Seed Treatment in Cumin four plots

S. No.	**Plot -1**	**Plot - 2**	**Plot - 3**	**Plot - 4**
Plant Treat.	Soil + Cumin	Soil + Cumin + Pesticides	Soil + Cumin + Bio-fertilizer	Soil + Cumin + Bio-fertilizer + Pesticides
Seed Treat.	----	**Seed Treatment** (Ampligo Insectisides)	**Seed Treatment** (PSB-Phosphorus Solubilizing Bacteria Biofertilizer)	**Seed Treatment** (Ampligo Insectisides and PSB)
Usage for Total seeds (5kg)	----	2ml 5lit water	25ml 300ml water	2ml 5lit water + 25ml 300ml water

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4.4 Methodology of Soil Treatment in Cumin Plots-

Table 2: Show Readings of Soil Treatment in Cumin four plots

S. No.	Plot -1	Plot - 2	Plot - 3	Plot - 4
Plant Treat.	Soil + Cumin	Soil + Cumin + Pesticides	Soil + Cumin + Bio-fertilizer	Soil + Cumin + Pesticides + Bio-fertilizer
Soil Treat	----	**Soil Treatment** (Tubeconazole Fungisides Spray)	**Soil Treatment** (Trichoderma viride Biofertilizer)	**Soil Treatment** (Tubeconazole and Trichoderma viride)
Dosage Per hact.	----	750ml 750lit water	10kg (powder) 2qt. cow dung	750ml 750lit water + 10kg (Powder) 2qt. cow dung

4.5 Seed weight & Spray- Seed variety GC-4 was weighed by weighing balance. After that the seeds showered by hand in each plot.

4.6 Chemicals & Bio agents- These were weighed by weighing balance. After that the pesticides and bio-fertilizer sprayed by sprayer in each plot.

4.7 Seed Germination & Seedling Growth - Germination percentage is an estimate of the viability of a population of seeds. The equation to calculate germination percentage is:

SGP = seeds germinated/total seeds x 100

The germination rate provides a measure of the time course of seed germination.

Fig 1: Shows the Measurement of Cumin Plot after 35 days of sowing

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Fig 2: Shows the Measurement of Cumin Plot after 70 days of sowing

4.8 Recording of readings of Seed Germination (%) of cumin crop after 20 days of sowing in eight villages at Nagaur region-

Table 3: Readings of Seed Germination (%) of cumin crop after 20 days of sowing in eight villages

S. No.	Village	P-1	P-2	P-3	P-4
1	Inana	66%	85%	70%	90%
2	Kuchera	45%	61%	58%	78%
3	Gaju	70%	86%	75%	95%
4	Chhilra	68%	83%	73%	93%
5	Balaya	76%	90%	86%	98%
6	Parashara	73%	88%	81%	96%
7	Silariya	55%	75%	68%	81%
8	Dehroli	50%	71%	63%	80%

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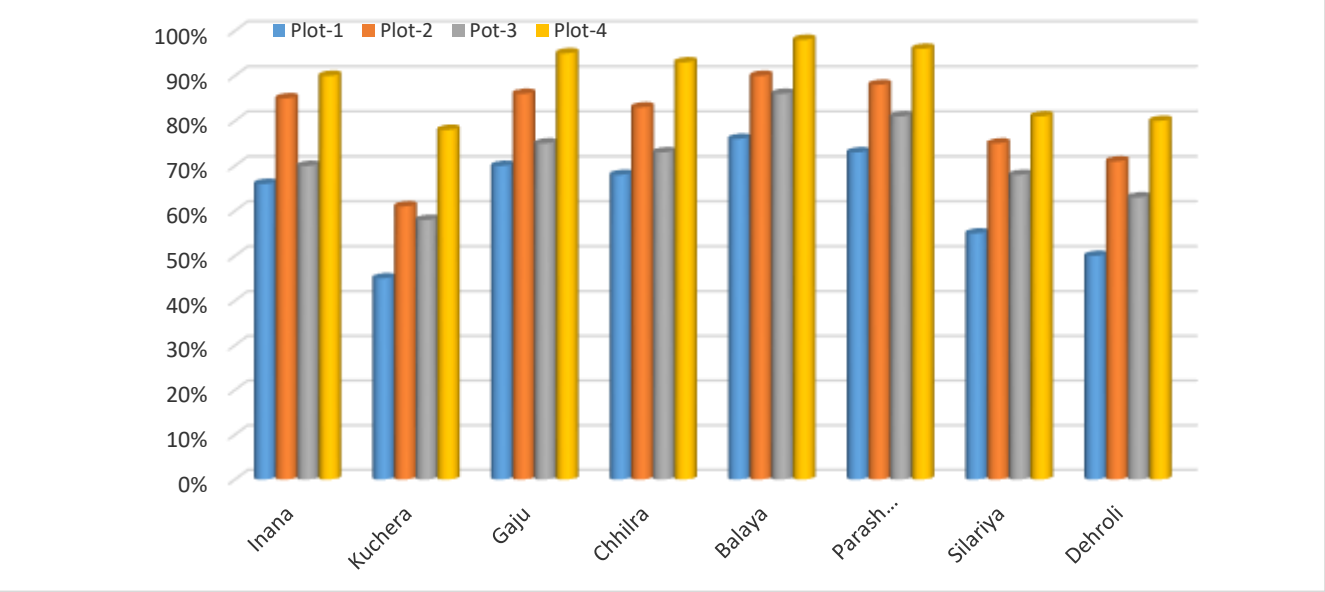
Fig 3: Shows the % of Seed Germination in four plots for eight villages



5. Data Analysis:

5.1 Recording of readings of plant growth parameters of cumin crop after 35 days of sowing in eight villages at Nagaur region.

5.1.1 Inana Village

Table 4: Readings of plant growth parameters of cumin crop after 35 days of sowing in Inana village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	3-6cm	6-9cm	5-8cm	7-10cm
5	No. of Plants	38	50	40	52
6	No. of Branches	1-2	3-4	2-3	4-5
7	No. of Spikes	5-8	8-12	6-10	10-15
8	Root Height	1-2cm	3-5cm	2-4cm	4-6cm
9	No. Root Branches	1-2	2-3	1-2	2-3
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

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5.1.2 Kuchera Village

Table 5: Readings of plant growth parameters of cumin crop after 35 days of sowing in Kuchera village

1	No. of Plot (4)	**P-1**	**P-2**	**P-3**	**P-4**
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	4-8cm	8-10cm	7-9cm	10-18cm
5	No. of Plants	25	35	33	45
6	No. of Branches	3-5	5-8	4-6	5-9
7	No. of Spikes	4-8	8-10	5-9	10-12
8	Root Height	1-3cm	3-5cm	2-5cm	4-6cm
9	No. Root Branches	1-2	2-3	1-2	2-4
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

5.1.3 Gaju Village

Table 6: Readings of plant growth parameters of cumin crop after 35 days of sowing in Gaju village

1	**No. of Plot (4)**	**P-1**	**P-2**	**P-3**	**P-4**
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	5-7cm	9-12cm	8-10cm	10-17cm
5	No. of Plants	40	51	43	56
6	No. of Branches	3-4	5-8	4-6	5-10
7	No. of Spikes	5-7	8-11	6-8	10-14
8	Root Height	1-3cm	3-5cm	2-4cm	4-7cm
9	No. Root Branches	1-2	2-3	1-2	2-4
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

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5.1.4 Chhilra Village

Table 7: Readings of plant growth parameters of cumin crop after 35 days of sowing in Chhilra village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	5-8cm	8-11cm	7-10cm	10-16cm
5	No. of Plants	39	48	42	54
6	No. of Branches	2-3	5-7	3-5	5-9
7	No. of Spikes	6-8	9-13	7-11	10-16
8	Root Height	1-3cm	3-6cm	3-4cm	4-6cm
9	No. Root Branches	1-2	3-5	2-4	3-5
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

5.1.5 Balaya Village

Table 8: Readings of plant growth parameters of cumin crop after 35 days of sowing in Balaya village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	6-9cm	10-14cm	9-11cm	15-20cm
5	No. of Plants	44	52	50	55
6	No. of Branches	4-6	6-10	5-8	6-11
7	No. of Spikes	13-20	20-27	18-24	30-37
8	Root Height	3-5cm	6-9cm	5-7cm	6-10cm
9	No. Root Branches	3-5	6-8	4-6	6-9
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

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5.1.6 Parashara Village

Table 9: Readings of plant growth parameters of cumin crop after 35 days of sowing in Parashara village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	5-8cm	9-13cm	8-10cm	13-18cm
5	No. of Plants	42	50	47	53
6	No. of Branches	3-5	5-9	4-7	5-10
7	No. of Spikes	11-26	18-25	15-21	28-34
8	Root Height	2-4cm	5-8cm	4-7cm	6-8cm
9	No. Root Branches	2-3	5-7	4-5	6-7
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

5.1.7 Silariya Village

Table 10: Readings of plant growth parameters of cumin crop after 35 days of sowing in Silariya village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	4-7cm	8-11cm	7-8cm	12-17cm
5	No. of Plants	31	43	39	47
6	No. of Branches	3-4	4-7	3-6	4-8
7	No. of Spikes	9-13	16-23	11-17	25-28
8	Root Height	2-3cm	4-7cm	3-6cm	6-7cm
9	No. Root Branches	1-3	4-6	3-5	5-7
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

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5.1.8 Dehroli Village:

Table 11: Readings of plant growth parameters of cumin crop after 35 days of sowing in Dehroli village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc (750ml)	-	Amp(2ml) Tebuc (750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	3-6cm	7-11cm	5-7cm	7-13cm
5	No. of Plants	28	41	36	45
6	No. of Branches	2-4	4-6	3-5	4-7
7	No. of Spikes	8-12	15-22	10-16	24-27
8	Root Height	2-3cm	3-6cm	2-5cm	5-6cm
9	No. Root Branches	1-2	2-4	1-3	4-5
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

5.2 Recording of readings of plant growth parameters of cumin crop after 70 days of sowing in eight villages at Nagaur region.

5.2.1 Inana Village

Table 12: Readings of plant growth parameters of cumin crop after 70 days of sowing in Inana village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	10-18cm	13-24cm	11-20cm	15-25cm
5	No. of Plants	33	45	35	48
6	No. of Branches	3-5	6-9	5-7	7-10
7	No. of Spikes	18-22	20-28	18-26	25-30
8	Root Height	3-4cm	5-7cm	4-6cm	6-8cm
9	No. Root Branches	2-3	3-4	2-4	3-5
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

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5.2.2 Kuchera Village

Table: 13: Readings of plant growth parameters of cumin crop after 70 days of sowing in Kuchera village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	10-18cm	12-22cm	11-20cm	12-25cm
5	No. of Plants	22	32	30	40
6	No. of Branches	4-7	6-10	5-9	6-11
7	No. of Spikes	18-22	27-32	23-26	30-35
8	Root Height	3-5cm	5-7cm	4-7cm	6-7cm
9	No. Root Branches	2-3	3-4	2-4	3-5
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

5.2.3 Gaju Village

Table 14: Readings of plant growth parameters of cumin crop after 70 days of sowing in Gaju village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	10-20cm	15-28cm	12-25cm	15-30cm
5	No. of Plants	36	48	40	54
6	No. of Branches	4-8	6-10	5-9	6-12
7	No. of Spikes	15-22	30-35	22-28	35-40
8	Root Height	2-4cm	5-8cm	4-5cm	6-9cm
9	No. Root Branches	2-3	3-4	2-3	3-4
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

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5.2.4 Chhilra Village

Table 15: Readings of plant growth parameters of cumin crop after 70 days of sowing in Chhilra village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	10-18cm	15-23cm	12-21cm	15-25cm
5	No. of Plants	34	45	38	50
6	No. of Branches	4-6	6-9	5-8	7-11
7	No. of Spikes	15-20	29-34	20-26	34-37
8	Root Height	3-4cm	4-7cm	3-6cm	5-7cm
9	No. Root Branches	2-3	3-5	3-4	4-6
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

5.2.5 Balaya Village

Table 16: Readings of plant growth parameters of cumin crop after 70 days of sowing in Balaya village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	10-22cm	16-30cm	13-27cm	18-35cm
5	No. of Plants	40	50	46	53
6	No. of Branches	4-8	7-13	7-10	8-15
7	No. of Spikes	20-28	32-37	30-35	38-50
8	Root Height	4-6cm	8-10cm	7-8cm	8-13cm
9	No. Root Branches	5-8	7-11	6-9	9-13
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

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5.2.6 Parashara Village

Table 17: Readings of plant growth parameters of cumin crop after 70 days of sowing in Parashara village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	10-20cm	15-28cm	12-24cm	16-33cm
5	No. of Plants	39	48	43	50
6	No. of Branches	4-6	7-11	6-9	8-14
7	No. of Spikes	18-25	30-34	28-33	35-48
8	Root Height	4-5cm	7-10cm	6-8cm	8-11cm
9	No. Root Branches	4-7	6-10	5-7	8-12
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

5.2.7 Silariya Village

Table 18: Readings of plant growth parameters of cumin crop after 70 days of sowing in Silariya village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	10-19cm	14-26cm	13-22cm	15-29cm
5	No. of Plants	26	39	34	44
6	No. of Branches	4-5	6-10	5-8	8-12
7	No. of Spikes	15-22	25-28	20-24	27-31
8	Root Height	3-5cm	6-9cm	5-7cm	7-10cm
9	No. Root Branches	3-4	5-8	4-6	7-9
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

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5.2.8 Dehroli Village

Table 19: Readings of plant growth parameters of cumin crop after 70 days of sowing in Dehroli village

1	No. of Plot (4)	P-1	P-2	P-3	P-4
2	Quantity of Pesticides/ hac.	-	Amp(2ml) Tebuc(750ml)	-	Amp(2ml) Tebuc(750ml)
3	Quantity of Bio-Fertilizer/ hac.	-	-	PSB (25ml) Td(10kg)	PSB (25ml) Td(10kg)
4	Plant Height	9-16cm	13-22cm	11-20cm	14-27cm
5	No. of Plants	24	36	31	42
6	No. of Branches	3-4	6-9	5-8	7-11
7	No. of Spikes	14-21	23-27	19-23	26-30
8	Root Height	3-4cm	6-8cm	4-6cm	6-9cm
9	No. Root Branches	2-3	4-7	3-5	6-8
10	Crop Geometry	15x10cm	15x10cm	15x10cm	15x10cm

6. Results:

6.1 One Way ANOVA to study the differences between seed germinations across eight villages:

Here we are trying to check if there is any effect due to the villages on the seed germination percentages. Following is the test expression that we are going to conduct. We conduct the following test at 95% level of significance i.e. alpha for the test is alpha=0.05

H0:V1=V2=V3=V4=V5=V6=V7=V8

Vs

H1: At least one pair of means are different from each other;

[Where VI indicates the mean germination of seed of all four plots for eight village]

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Table 20: Readings of One Way ANOVA to study the differences between seed germinations across eight villages

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.34	7.00	0.05	3.15	0.02	2.42
Within Groups	0.37	24.00	0.02			
Total	0.71	31.00				

Table 21: Readings of One Way ANOVA to study the differences between seed germinations across eight villages (Average)

SUMMARY				
Groups	*Count*	*Sum*	*Average*	*Variance*
Inana	4.00	2.43	0.61	0.02
Chhilra	4.00	2.50	0.63	0.01
Gaju	4.00	2.70	0.68	0.02
Kuchera	4.00	1.72	0.43	0.01
Parashara	4.00	2.78	0.70	0.01
Baliya	4.00	2.96	0.74	0.01
Dehroli	4.00	1.92	0.48	0.02
Silariya	4.00	2.06	0.52	0.02

The output tells us that the P-value is significantly less than the alpha (0.05) and hence we reject the null hypotheses. Clearly that indicates the group means are not equal or in other words there is some effect due to the villages on the seed germination percentage at 95% level of significance. This table tells us that the highest value of Seed Germination was found in Balaya Village (0.74) and lowest Value was found in Kuchera Village (0.43).

6.2 One Way ANOVA to study the differences between seed germinations across Four Plots:

Here we are trying to check if there is any effect due to the plot types on the seed germination percentages. Following is the test expression that we are going to conduct. We conduct the following test at 95% level of significance i.e. alpha for the test is alpha=0.05

H0:P1=P2=P3=P4

Vs

H1: At least one pair of means are different from each other;

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[Where Pi indicates the mean germination of seed of all eight villages for four plot]

Table 22: Readings of One Way ANOVA to study the differences between seed germinations across four plots

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.37	3.00	0.12	9.87	0.00	2.95
Within Groups	0.35	28.00	0.01			
Total	0.71	31.00				

Table 23: Readings of One Way ANOVA to study the differences between seed germinations across four plots (average)

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Soil + Cumin	8.00	3.64	0.46	0.01
Soil + Cumin + Pesticides	8.00	5.20	0.65	0.01
Soil + Cumin + Bio-fertilizer	8.00	4.33	0.54	0.01
Soil + Cumin + Bio-fertilizer + Pesticides	8.00	5.90	0.74	0.01

The output tells us that the P-value is significantly less than the alpha (0.05) and hence we reject the null hypotheses. Clearly that indicates the group means are not equal or in other words there is some effect due to the villages on the seed germination percentage at 95% level of significance. This table tells us that the highest value of Seed Germination was found in Plot no.-4 (0.74) and lowest Value was found in Plot no.-1 (0.46).

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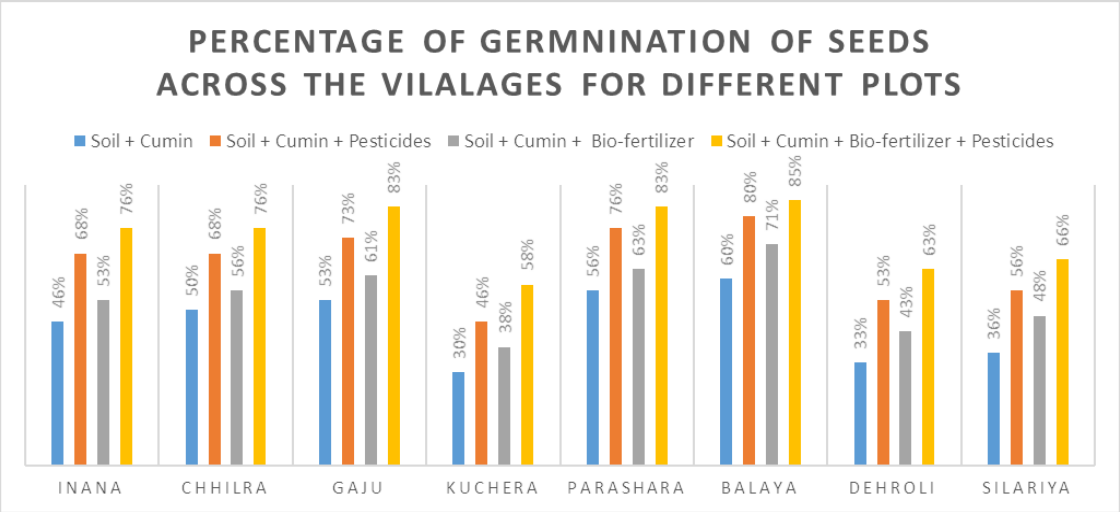
6.3 This chart show % of Seed Germination in four plots for eight villages:

Fig 4: shows that % of Seed Germination in four plots for eight villages

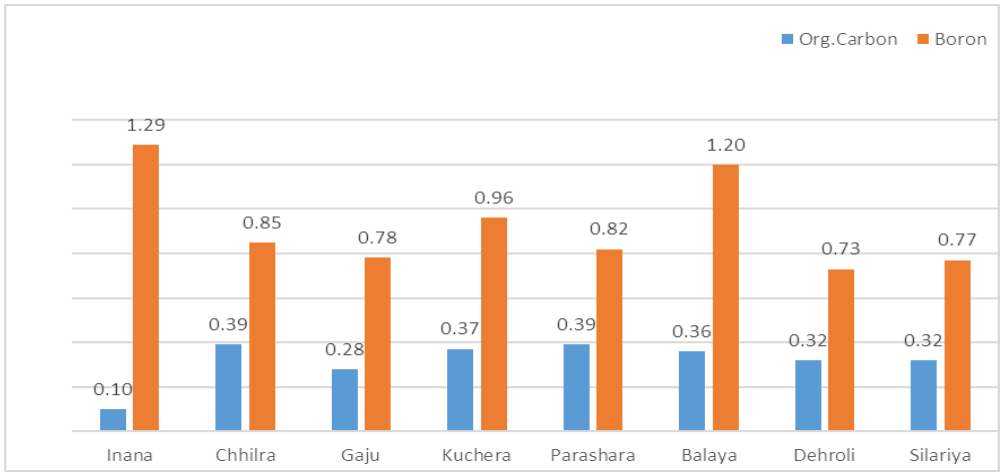


This chart tells us that there is significant difference between the two villages namely Balaya and Kuchera. The former one is among the highest and the later one is among the lowest. The graph also tells us that use of pesticide is giving significantly higher germination.

6.4 Distribution of Soil parameters across the eight villages:

6.4.1 Organic carbon and Boron:

Fig 5: shows that Organic carbon and Boron in four plots for eight villages



This chart tells us that the highest value of OC was found in Chhilra and Parashara Village (0.39%) and lowest Value was found in Inana Village (0.10%). Similarly the highest value of Boron was found in Inana Village (1.29ppm) and lowest Value was found in Dehroli Village (0.73ppm).

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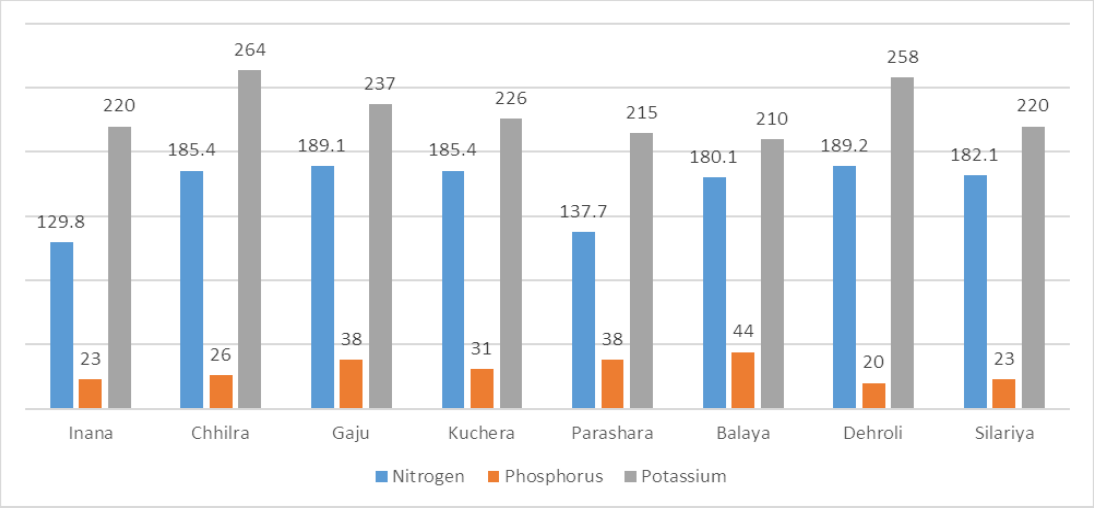
6.4.2 Nitrogen, Phosphorus and Potassium:

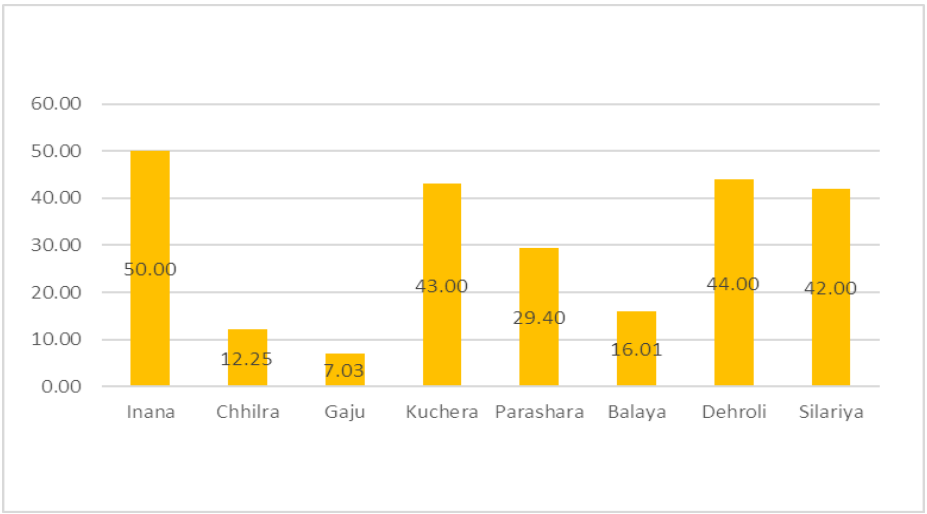
Fig 6: show that Nitrogen, Phosphorus and Potassium in four plots for eight villages



This chart tells us that the highest value of Nitrogen was found in Dehroli Village (189.2kg/ht) and lowest Value was found in Inana Village (129.8kg/ht). Similarly the highest value of Phosphorus was found in Balaya Village (44kg/ht) and lowest Value was found in Dehroli Village (20kg/ht). Similarly the highest value of Potassium was found in Chhilra Village (264kg/ht) and lowest Value was found in Balaya Village (210kg/ht).

6.4.3 Sulfur:

Fig 7: shows that Sulfur in four plots for eight villages



This chart tells us that the highest value of Sulfur was found in Inana Village (50ppm) and lowest Value was found in Gaju Village (7.03ppm).

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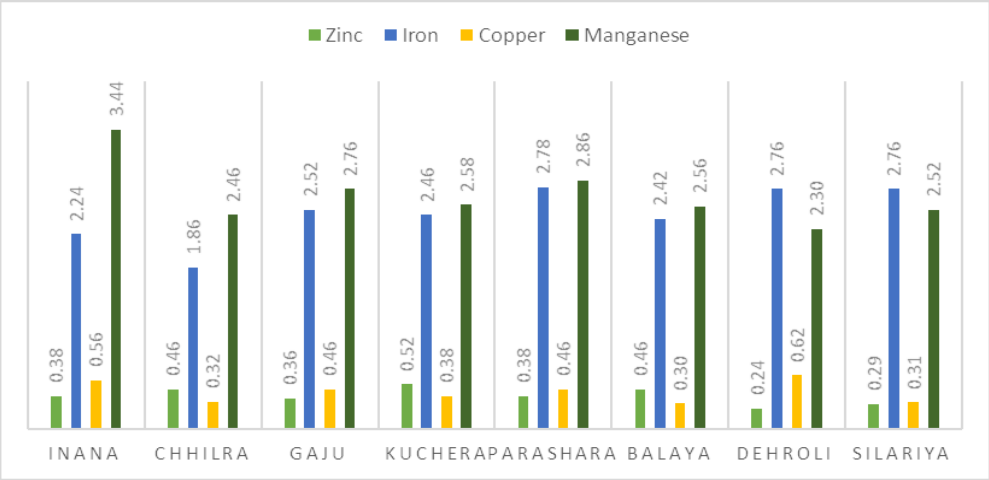
6.4.4 Zinc, Iron, Copper and Manganese:

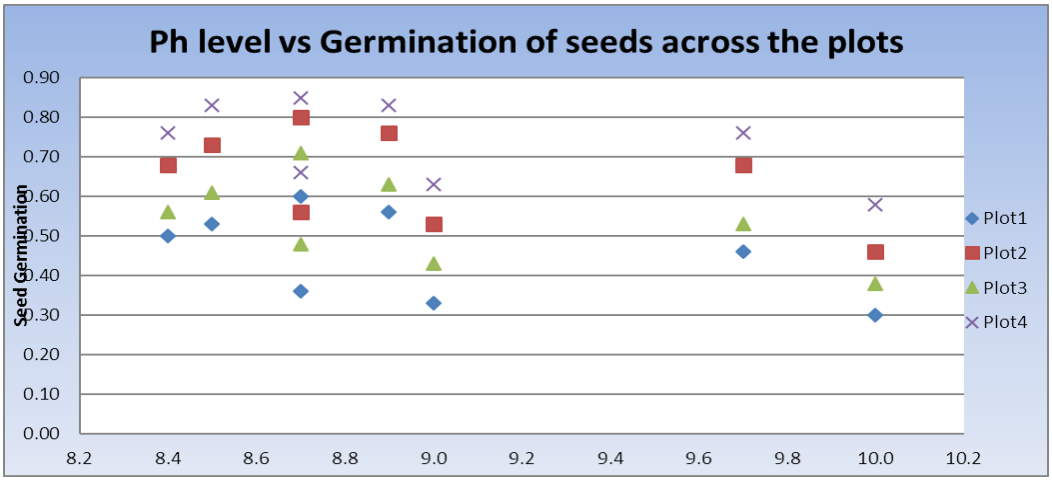
Fig 8: show that Zinc, Iron, Copper and Manganese in four plots for eight villages



This chart tells us that the highest value of Zinc was found in Kuchera Village (0.52ppm) and lowest Value was found in Dehroli Village (0.24ppm). Similarly the highest value of Iron was found in Parashara Village (2.78ppm) and lowest Value was found in Chhilra Village (1.86ppm). Similarly the highest value of Copper was found in Dehroli Village (0.62ppm) and lowest Value was found in Balaya Village (0.30ppm). Similarly the highest value of Manganese was found in Inana Village (3.44ppm) and lowest Value was found in Dehroli Village (2.32ppm).

6.4.5 pH Level vs Germination of seeds across the plots:

Fig 9: show that pH Level vs Germination of seeds across the plots for eight villages



This chart tells us that the highest value of Germination of seeds was found in P-4 Plot of Balaya village (98%) and lowest Value was found in P-1 Plot of Kuchera village

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(45%). Because the pH of the soil of Balaya village (8.7) was found to be low and the pH of the Soil of Kuchera village (10) was found to be high.

7. Conclusion:

Pesticides and biofertilizers were not sprayed in any plot for 35 days and sprayed after 35 days. Biofertilizer and pesticides were not sprayed in P-1 plot of cumin, which yielded less seed germination percentage and in P-4 plot both biofertilizer and pesticide were used together, which yielded higher seed germination percentage. Within 35 days of sowing cumin seeds, weeds occurred in very large quantity due to no spray of any kind of pesticides and biofertilizers and after 35 days, weed occurred in very less quantity due to spraying of pesticides and biofertilizers. The growth of plant height, root height, no. of spikes and no. of root branches become normal due to not spraying any kind of pesticides and biofertilizer and spraying of pesticides and biofertilizer accelerated plant growth. The disease resistance was higher in 70 days crop as compared to 35 days cumin days. The highest value of Germination of seeds was found in Balaya Village and lowest Value was found in Kuchera Village. Because the pH of the soil of Balaya village (8.7) was found to be very low and the pH of the Soil of Kuchera village (10) was found to be high.

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