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Study on the Effect of Fertilizers and Hydrogen Peroxide on Soil Property, Growth, Yield and Nutrient Content of *Abelmoschus Esculentus* (L.) Moench

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ABSTRACT

Effect of the application of individual and combination of vermicompost, NPK along with H_2O_2 was studied on 10, 20, 30, and 40 days old seedlings of Abelmoschus esculentus. The physio chemical characters of soil with vermicompost showed better result and it has all kinds of nutrient needed for the better growth of the crop. It increases soil fertility, crop production and nutrient content of the plants. Integrated fertilizer application will boost the crop and this is the best way to obtain better results and it will decrease the pollution load on our environment. Application of H_2O_2 also influences the germination, early plant growth and nutrient content. It act as a growth promoter, but the continuous application and accumulation leads to damages, and the disease resistance against pathogens was decreased during the reproductive stages.

Keywords:
Abelmoschus esculentus; Growth; H_2O_2; Fertilizer; Soil

1. Introduction

Agriculture success mainly depends on soil quality, plant health, climate and well balanced fertilizer application. In today's era, farmers use heavy doses of inorganic fertilizers to fulfill the food demand. Intensive agriculture has increased crop yields but also posed severe environmental problems (Pimentel, et al., 1995). Sustainable agriculture would ideally produce good crop yields with minimal impact on ecological factors such as soil fertility (Tilman,1999; Pimental, 1997). A fertile soil provides essential nutrients for crop plant growth, supports a diverse and active biotic community, exhibits a typical soil structure, and allows for an undisturbed decomposition (Mader, et al., 2002).

Okra (*Abelmoschus esculentus* L) is an annual herb and vegetable crop grown throughout the tropical and subtropical parts of the world either as the sole crop or intercrop with maize or another (Emuh et al., 2006). Okra plays an important role in the

human diet by supplying carbohydrate, protein, fats, minerals and vitamins that are usually deficient in the staple food. The nutritional importance of okra pod has reawakened interest in bringing the crop into commercial production (El-Kader et al., 2010).

Application of organic manure along with inorganic fertilizer for soil fertility and desired productivity is the key for agricultural success and sustainability. Well balanced fertilization is the main concept of commercial cultivation. Integrated application of vermicompost and inorganic fertilizer (NPK) leads to fulfill the nutrient requirement of the plants and influences the activity of the beneficial soil microflora. Hydrogen peroxide plays a crucial role in the physiological activity of the plants and produced predominantly during photosynthesis and photorespiration. Level of H_2O_2 increased due to environmental stress. Therefore, the present study was carried out with the following objectives.

- To assess the impact of vermicompost and NPK individually and combination of vermicompost and NPK along with H_2O_2 forming practices on the physiochemical properties of soil.
- To assess the impact of individual and in combination of vermicompost and NPK along with H_2O_2 on growth and yield of *Abelmoschus esculentus*.
- To characterize the influence of exogenous application of hydrogen peroxide on growth and development and intact seedlings of various ages.
- To find out seedling age suitability for H_2O_2 induced growth enhancement and reducing soil and water born disease of the seedlings. It is anticipated that any beneficial role of H_2O_2 on *Abelmoschus esculentus*. Growth and physiology would be of major agricultural significance especially under water stagnant environment and salinity.

2. Materials and Methods

A. esculentus was grown in a pot treated with organic fertilizer (vermicompost), inorganic fertilizer (NPK) and H_2O_2. The composition of organic and inorganic fertilizers was given below.

Treatment 1: Soil (control)

Treatment 2: Soil + vermicompost (50 grams)

Treatment 3: Soil + NPK (5 grams) Treatment 4: Soil + H_2O_2 (5ml)

Treatment 5: Soil + vermicompost (25 grams) + NPK (2.5 grams)

Treatment 6: Soil + vermicompost (50 grams) + H_2O_2

Treatment 7: Soil + NPK (5 grams) + H_2O_2

Treatment 8: Soil + vermicompost (25 grams) + NPK (2.5 grams) + H2O2. The morphological parameters where studied from 10^{th}, 20^{th}, 30^{th} and 40^{th} day interval.

Seed germination percentage:

Seed germination study was carried out from 7th day onwards.

Germination percentage = (No. of seeds germinated)/(Total no.of seeds sown) ×100

Length of the root and shoot:

The root and shoot length was taken with the help of thread and ruler method and was recorded in centimeters.

Vigor index:

Vigor index was calculated using the following formula.

Vigor Index = (Root length + Shoot length) x Percentage of germination

Leaf area

The number of leaves per plant was counted and the leaf area was calculated by counting the squares in graph sheet. The average leaf area in each was expressed in cm2.

Physiochemical properties of soil

PH:

5 gram of soil from each treatment and control was weighed separately which was suspended in 10 ml of distilled water, shaken for 30 minutes and pH of the supernatant was measured using pH meter.

Electrical conductivity (d S m-1)

5 gram soil from each treatment and control was taken separately and dissolved in 10 ml of distilled water and mixed. The solution was used to measure the conductivity with the help of an electrical conductivity meter.

Nutrient analysis of the soil:

The nutrient profile of the soil such as N, P, K, Cu, Zn, Fe, Mn was analyzed.

Quantitative estimation on the yield of *Abelmoschus esculentus* (L.) Moench

Total soluble protein (Lowry et.al.,1951)

About 2g of plant sample was soaked in 50 ml of ethanol for 24 hrs. and filtered through a muslin cloth and centrifuged at 3000 rpm for 10 minutes. To the supernatant 10% trichloro acetic acid (TCA) was added in 1:1 ratio and left in an ice bath for 30 minutes to precipitate protein. Then centrifuged at 3000 rpm for 5 minutes and discarded the supernatant. The precipitate was dissolved in 0.1N sodium hydroxide and diluted to a known volume.

To 0.5 ml of protein extract, 5 ml of alkaline copper reagent was added. After thorough mixing 0.5 ml of folin ciocalteau reagent was added and allowed to stand for 30 minutes; the blue colour appeared and absorbance was measured at 650 nm using UV visible spectrophotometer (Model No: UV 2371). Amount of protein was calculated and expressed as mg/g DW. Bovine serum albumin (BSA) was used as standard.

Total carbohydrate (Dubois, et al., 1956)

1 gram of plant material was soaked in 25ml of ethanol for 24 hrs. and filtrate through a muslin cloth. To 0.1 ml of the filtrate, 0.9 ml of distilled water, 1 ml of 5% phenol and 5 ml of 96% sulphuric acid were added. The contents were shaken well and after 30 minutes absorbance was read at 490 nm. Glucose was used as standard.

3. Results and Discussion

3.1 Physiochemical properties of field soil

The results of physiochemical parameters of the filed soil used for this study were presented in Table – 1&2. The pH of the field soil was initially alkaline then it becomes neutral due to the application of vermicompost. The initial EC value of the soil found to be lesser (0.4ds m-1) than that of field soils treated with fertilizers. Same type of results was observed by Akande et al 2010. Each treatment exhibited its effect on soil profile.

Table 1. Effect of fertilizers and H_2O_2on the physical property of the soil.

Treatment	PH	EC (ds m^{-1})
Initial	7.1	0.4
T1	7.1	0.39
T2	6.8	0.45
T3	7.3	0.47
T4	7	0.45
T5	7	0.42
T6	6.9	0.52
T7	7.1	0.52
T8	6.9	0.49

Table 2. Effect of fertilizer and H_2O_2 on soil nutrient content (kg/ac)

Treatment	Macro nutrients			Micro nutrients			
	N	P	K	Fe	Zn	Mn	Cu
Initial	35	9	153	3.336	0.932	2.224	1.052
T1	34	8	122	2.84	0.656	1.656	0.42
T2	53	21	194	6.738	1.994	4.94	2.466
T3	36	25	199	2.972	0.738	1.902	0.602
T4	32	7	145	3.072	0.774	1.92	0.686
T5	55	29	203	5.252	1.67	3.244	1.618
T6	45	18	171	4.062	1.014	2.866	1.484
T7	53	22	176	3.236	0.79	2.186	0.952
T8	49	27	189	3.789	0.964	2.864	1.268

3.2 Effect of fertilizers and H_2O_2on the growth of *Abelmoschus esculentus*

Seed germination

In the present study, Germination percentage was determined in each of the eight treatments Table - 3. It was observed that germination percentage was maximum (90%) in treatment T4, T5, T6 and T8. Hydrogen peroxide (H_2O_2) increased the germination percentage of pea seeds, as well as the growth of seedlings in a concentration-dependent manner (Barba-Espin et al., 2010). Vigor index was and total length of the seedling was found to be higher in T8.

Table 3. Effect of fertilizer and H_2O_2 on 10 days old seedling of *Abelmoschus esculentus*

Treatment	Germination percentage	Total length of the seedling (cms)	Vigor index
T1	70	3.56	249.2
T2	80	5.7	456
T3	85	6.4	544
T4	90	4	360
T5	90	7.7	693
T6	90	6.4	576
T7	85	6.1	518.5
T8	90	8.2	738

Seedling growth

Seedling stage is the most sensitive stage in the life cycle of plant and hence it is susceptible to physical and chemical adversities. The application of different levels of vermicompost, NPK, H_2O_2 increased the growth and development pattern of seedlings. In this field experiments, the seedling height was significantly higher in *A. esculentus* plants that were amended with T8 than other treatments. On 20th and 30th day it shows higher shoot length and root length with the addition of H_2O_2 than other seedlings which are not treated with H_2O_2. After 40 days the root and shoot length shows considerable changes. Growth of the seedlings which are treated with H_2O_2 become suppressed and inhibited when compared to the seedlings which are not treated with H_2O_2. This may be due to the metabolic activity (Barba-Espin et al., 2010)

Table 4. Effect of fertilizers and H_2O_2 on the growth of 20, 30, 40 days old seedling of *Abelmoschus esculentus.*

T	Shoot length (cms)			Root length (cms)		
	20^{th} day	30^{th} day	40^{th} day	20^{th} day	30^{th} day	40^{th} day
T1	10.7	19	22.4	6.4	7	7.8
T2	11	19.5	27.2	4.4	4.9	9.1
T3	11.9	20.3	25.7	5.3	8.7	8.9
T4	11.2	19.3	21.9	4.5	7.4	8.3
T5	12.3	20.9	28.8	7.2	9.8	12.7
T6	11.8	19.8	24.3	4.2	5.3	7.9
T7	13.4	21	25.2	5.1	9.1	9.3
T8	13.9	21.8	26.3	6	10.4	10.8

Number of leaves and leaf area

Leaf area is an important part of the plant responsible for interception and conversion of solar energy (Sarkar et al., 1995).The leaf area of *A. esculentus* was higher in T5 and T8 than other treatments.But after 30 days there is no significant development in T4.

Table 5. Effect of fertilizer and H_2O_2 on number of leaves and leaf area on 20, 30, 40 days old seedling of *Abelmoschus esculentus*.

Treatment	No. of leaves			Leaf area (Cms^2)		
	20th day	30th day	40th day	20th day	30th day	40th day
T1	4	6.9	8.1	10.2	22.4	34.5
T2	5	7.7	9	11.75	25.15	44
T3	5.2	7.9	9.3	14.06	33.05	51
T4	4.5	7.2	7.5	13.6	24.73	31.3
T5	5.7	8.5	10	18.81	37.8	61.5
T6	5.3	8	7.7	15.07	29.05	35.7
T7	5.5	8.2	9	22.5	34.25	43.8
T8	6	8.8	8.8	20.5	44.9	52.21

Yield and fruit weight

Table – 6 shows the number of days required for the plant *Abelmoschus esculentus* to produce fruits. T2 Plants required 47 days, T3 – 51 days T5 – 49 days when compared to T1 (51 days). Application of H_2O_2 leads to delaying in yielding (T4– 60 days, T6– 62 days, T7- 67 days and T8 64 days) and it cause early maturation of the fruits and has less weight.

Table 6. Effect of fertilizer and H2O2 on day of yield and weight of the fruit of *Abelmoschus esculentus*

T	Day of yield	Fresh weight (g)	Dry weight (g)
T1	51	4.7	1.5
T2	47	5.2	1.8
T3	51	4.9	1.6
T4	60	4.3	1.1
T5	49	5.4	2
T6	62	2.6	0.7
T7	67	2.7	0.77
T8	64	4.1	0.92

3.3 Estimation of nutrient content

Fruits obtained from the *Abelmoschus esculentus* were dried and powdered separately and the protein and carbohydrates were estimated. Fruits which are obtained from the plant which are treated with H_2O_2 show higher protein and carbohydrate content than other treatments.

Table 7. Effect of fertilizer and H2O2 on nutrient content of *Abelmoschus esculentus* fruit (mg/g dryweight)

Treatment	Protein mg/g DW	Carbohydrate mg/g DW
T1	20.7	15.9
T2	16.5	24.7
T3	15.6	21.3
T4	28.2	17.1
T5	33.8	25.5
T6	17.3	26.3
T7	36	28.4
T8	41.8	29.7

4. Conclusion

The physico chemical characters of soil with vermicompost showed better result and it has all kinds of nutrient needed for the better growth of the crop. But at the same time integrated nutrient amendment plays a multiple role in agriculture and environment. It increases soil fertility, crop production and nutrient content of the plants and more over it influences the soil microflora. Sole use synthetic fertilizers like nitrogen, phosphorous, potassium, urea etc., are leads to increase in nutrient profile of the soil but it also affects the soil quality, suitability and alter the soil pH. Continuous application of synthetic fertilizers made our mother earth to become unfit for agriculture and crop production. Integrated fertilizer application will boost the crop and this is the best way to obtain better results and it will decrease the pollution load on our environment. I recommend that farmers should be educated about the importance of fertilizer application and management. Application of H_2O_2 also influences the germination, early plant growth and nutrient content. It act as a growth promoter, but the continuous application and accumulation leads to damages, and the disease resistance against pathogens was decreased during the reproductive stages. From the findings it can be concluded that, further research is necessary to study the effect of exogenous application H_2O_2 on plant growth, reproduction and cellular metabolism.

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