EFFICACY OF DIFFERENT FERTILIZERS CONCENTRATION ON HYDROPONICALLY GROWN BROCCOLI UNDER GREENHOUSE CONDITION

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ABSTRACT: Hydroponic (soilless culture) is an alternative flowers, fruits and vegetables production method. It may comprise pure water or substrate culture. Greenhouses are permanent structure that allows the farmers to grow vegetables and fruits year-round with mechanically-controlled temperature and irrigation system. Crop yield increases with ideal water and fertilizer usage in hydroponic agriculture. Farmers are growing broccoli under greenhouse conditions using irrigation water with random nutrients application. However, database for optimum production of broccoli is required in order to reduce cost of production and increasing profit. Broccoli was grown on tap water, straight fertilizer and soluble fertilizer. The evaluation of these treatments (fertilizer concentration) was conducted on the basis of sulforaphane content, vitamin C, nitrate, weight of broccoli florets and total broccoli yield. Data collected from the experiment were statistically analyzed at 5% level of probability. Statistical results illustrated that hydroponic recipe with soluble fertilizer performed better as compared to tap water and NPK straight fertilizer.

Keywords: Hydroponic, Broccoli, Greenhouse, Yield,

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INTRODUCTION

First commercial based hydroponic system was introduced in 1930's. Since then, this system has improved significantly which is the evident of its high production and quantity of the crops produced. Greenhouses offer one of the optimistic approaches to ensuring sustainable food production in water stressed and urban environment. Hydroponic agriculture is the science of growing plants in inert media such as coco cake/powder, gravel, sand, peat, vermiculite, pumice, or sawdust, rather than in soil [1][18][19]. This farming produces new prospects to additional fields of modern agribusiness. It contains covered fruits, vegetables roofs, green walls, vertical farming, horticulture or rural peri-urban and intra-urban landscaping [2]. The epidemiological research has observed that the nutritive in-take of brassica vegetables especially broccoli can bring the chances of chronic diseases most like as atherosclerosis and cancer [3].

One of the important Cole crops worldwide is broccoli (Brassica oleracea L. var. italica). Broccoli's health advantages are partly linked to secondary plant substances having antioxidant activity [4]. Nitrogen (N) has a significant impact on the growth and development of plants. In order to grow vegetables profitably, nitrogen is a crucial component that is especially vital when growing vegetables in less fertile soil. The additional N is believed to lower overall crop yield risk [5]. It is possible to overcome the house problem by boosting the production of nutritious foods and crops. However, without the availability of vital plant nutrients, the goals of food security cannot be met [6].

As a result, plant nutrients are a crucial part of sustainable farming. Unquestionably, the necessary nutrients must be easily available in adequate quantities and in a balanced proportion for optimum plant production. Chemical fertilizers are the easily accessible sources that offer crucial nutrients and maintain a positive equilibrium. However, a suitable and balanced combination of macro and micronutrients is beneficial for the environment as well as plant growth and production [7]. The growth and development of a plant depend on macronutrients, such as nitrogen, which promotes vegetative growth [8] and potassium plays a crucial role in glucose metabolism, enzyme activation, and osmotic regulation while phosphorus promotes root development and also provides energy [9]. Nitrogen is one of the

element that has the greatest impact on crop yield. However, overuse of this element in fertilizer causes environmental contamination because NO3 is released into the soil profile by precipitation water, which then contaminates groundwater and surface watercourses [10]. Since it is involved in metabolic processes such protein synthesis, enzyme activation, membrane transport processes, charge balance, and the production of turgor pressure, potassium is one of the components that greatly affects tomato quality [11]. Although nitrate assimilation in the roots frequently plays a significant role in these plants' early growth stages, nitrate assimilation in the majority of fully grown herbaceous plants largely happens in the leaves. The use of mechanization in nursery raising, transplanting, interculture, irrigation, plant protection, pruning, harvesting, and processing has a great impact on the whole production cycle [12][16].

Due to its characteristics, vitamin C (also known as ascorbic acid) is a particularly powerful antioxidant. It lowers the risk of cardiovascular disorders and can operate as an anti carcinogenic agent. Numerous researches have looked into vitamin C's potential antioxidant effects. Vitamin C reduces the development of cancer by suppressing stomach nitroso compounds and boosting the immune system. Several variables, including species and variation, affect vitamin C levels. [13][17].

MATERIALS AND METHODS

Keeping in view research objective an experiment was conducted to evaluate the efficacy of different fertilizers concentration on broccoli production.

Study area: The broccoli was grown at Premier Industrial Chemical Company Sheikhupura Road Lahore Pakistan during cropping season of 2021. Experimental area lies in semi-arid region, approximately 144 meters above sea level with hot and humid summers, while with cool and dry winters. The temperature normally average ranges during winter 5-17°C while in summer 26-39°C, while seldom extreme temperature touch even -2°C in winter to 50°C in hot summer with mean rainfall of 548mm.

Nursery raising: In this experiment broccoli seed were sown in early winter in media peat moss, perlite and vermiculite. For proper growth water was sprinkler on the nursery twice in a week. These seedlings were transplanted in another media which having the combination ratio of coco peat, perlite and vermiculite. After 28 days when the seedlings get mature, they were transfer to their finishing channel and each fertilization/nutrient combination was examined by four replications.

Experimental treatments: Crop water requirements were fulfilled with the help of high efficiency irrigation system by using netafim fertigation machine viva drip line. No chemical (fungicides, insecticides) applied as control environment in greenhouse prevent entry of insects. The experiment was compared with control treatment and applying NPK straight fertilizer. In this study, the impact of $CaNO_3$, KNO_3, MKP & Micro elements nutrients application was tested to see how it affected the yield and quality of broccoli.

Three different treatments for production of broccoli were:

T_1 Control: 0 (without application of fertilizers),

T_2 Application of NPK straight fertilizer 25l/hr.

T_3 Application of $CaNO_3$, KNO_3, MKP and Micro elements nutrients 0.4l/hr

In treatment T_1 tab water while for in treatment T_2 and T3 RO water was used maintaining pH (5.8 to 6.4) and EC (1.6 to 2.2).

Variables to be measured: Broccoli plants were grown under hydroponic system and the performance of different treatment was conducted on the base of sulforaphane content, vitamin C, nitrate, weight of broccoli florets and total broccoli yield.

Statistical analysis: The data collected were statistically analyzed by using *Statistix 8.1* software. Analysis of variance (ANOVA) was used to determine the results, and the Tukey's HSD test was carried out at 5% level of probability.

RESULTS AND DISCUSSION

Data for various parameters in different treatments were taken, statistically analyzed and their mean values are presented below for proper understanding and discussion.

Sulforaphane content: The highest (106.00g) sulforaphane level in broccoli was observed in treatment T_3 while minimum value (43.000g) was observed in treatment T_1. A byproduct of glucoraphanin (GRA) breakdown is sulforaphane (SF). As a result, both the GRA content and the activity of the enzyme myrosinase, which breaks down GRA, affect the SF content [14].

According to [15], the application of $CaNO_3$, MKP boosted myrosinase activity, which had the effect of increasing the SF concentration in broccoli florets. Similar to this, each year of the current experiment revealed a statistically significant rise in the SF content of broccoli florets treated with nutrients of $CaNO_3$, KNO_3, and MKP spraying. Comparing the treatment $CaNO_3$, KNO_3, and MKP to the control, the SF level in each was about 106.00 mg kg-1 greater.

Table 1. Effect of Different Fertilizers on Sulforaphane Contains

	Treatments	Sulforaphane contents (g)
T_1	Control	43.000 C
T_2	NPK	79.133 B
T_3	$CaNO_3$, KNO_3, MKP @ micro-nutrients	106.00 A
CV		5.53

Vitamin C: Vitamin C content in treatment T_1, T_2 and T_3 was recorded as 702.33, 773.00 and 825.00g respectively. Maximum Vitamin C content (825.00g) was observed in treatment T_3 while T_2 gained second position (773.00g) and the minimum content (702.33g) was observed in treatment T_1.

Table 2. Effect of different fertilizers on vitamin c contents

	Treatments	Vitamin C contents (g)
T_1	Control	702.33 B
T_2	NPK	773.00 AB
T_3	$CaNO_3$, KNO_3, MKP @ micro-nutrients	825.00 A
CV		6.90

Nitrate content: Nitrate content in treatment T_1, T_2 and T_3 was recorded as 185.67, 723.33 and 464.33g respectively. Maximum Nitrate content (723.33g) was observed in treatment T_2 while T_3 gained second position (464.33g) and the minimum content (185.67g) was observed in treatment T_1.

In treatment T_2 Broccoli florets accumulated 33.4% higher nitrate contents as compared to treatment T_3 as a result of the usage of NPK fertilizers. The statistical analysis shown that Nitrate Contents were significantly different in all treatments (T_1, T_2 and T_3) at 5% level of probability.

Table 3. Effect of Different Fertilizers on Nitrate Contents

	Treatments	Nitrate contents (g)
T_1	Control	185.67 C
T_2	NPK	723.33 A
T_3	$CaNO_3$, KNO_3, MKP @ micro-nutrients	464.33 B
CV		1.80

Weight of broccoli florets: Weight of Broccoli Florets in treatment T_1, T_2 and T_3 was recorded as 351.67, 260.00 and 351.67g respectively. Weight of broccoli florets (351.67g) was observed same in treatment T_1 and T_3 while the minimum content (260.00g) was observed in treatment T_2. Statistical analysis shown that there was no significant difference between treatments T_1 and T_3 while there was significant difference in treatment T_1 and T_2 and T_2 with T_3 at 5% level of probability.

Table 4. Effect of Different Fertilizers on Weight of Florets (g)

	Treatments	Weight of broccoli florets (g)
T_1	Control	351.67 A
T_2	NPK	260.00 B
T_3	$CaNO_3$, KNO_3, MKP @ micro-nutrients	351.67 A
CV		4.15

Total broccoli yield: Total broccoli yield in treatment T_1, T_2 and T_3 was recorded as 30000, 50000 and 93333 kg/acre respectively. Maximum broccoli yield (93333kg/acre) was observed in treatment T_3 while T_2 gained second position (50000kg/acre) and the minimum yield (30000kg/acre) was observed in treatment T_1. Statistical analysis shown that total broccoli yield was significantly different in all treatments (T_1, T_2 and T_3) at 5% level of probability.

Table 5. Effect of Different Fertilizers on Broccoli Yield/ acre

	Treatments	Broccoli yield/ acre (kg/acre)
T_1	Control	30000 C
T_2	NPK	50000 B
T_3	$CaNO_3$, KNO_3, MKP @ micro-nutrients	93333 A
CV		23.54

Conclusion: Data collected from the experiment shown that hydroponic recipe with $CaNO_3$, KNO_3, MKP @ micro-nutrients shown better performance as compared to Control and NPK fertilizer treatments.

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