



# Effect of Panchagavya and Leaf Extracts of Moringa, Neem and Seaweed on Growth, Yield and Yield Attributing Traits of Spinach (*Spinacia oleracea* L)

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## Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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## ABSTRACT

The present investigation was carried out at Field Experimentation Centre, Department of Genetics and Plant Breeding, Sam Higginbottom University, Technology and Sciences, Prayagraj (UP) for "Effect of Panchagavya and Leaf Extracts of Moringa, Neem and Seaweed on Growth, Yield and Yield Attributing Traits of Spinach (*Spinacia oleracea* L) Variety-All Green". The experiment was laid out in Randomized Block Design with thirteen treatments including control which were replicated thrice on spinach seed variety 'All-Green' were used to study under field conditions. The treatments were as follows, T0- Control, T1,T2,T3 – Panchagavya @ (3,5,7%) for 8Hrs, T4,T5,T6 – Neem leaf extract @ (3,5,7%) for 8hrs, T7,T8,T9 – Moringa leaf extract @ (3,5,7%) for 8hrs, T10,T11,T12 – Seaweed liquid extract @ (2,4,6%) for 8hrs respectively. ANOVA given the significance difference among all treatments compared to control for all parameters under study. It is concluded from the present study that the seeds of Spinach variety – All Green treated with T10-Seaweed Liquid Extract @ 2% for 8hrs was recorded the highest Number of leaves(19), length of leaf (cm)(12.8), No. of seeds per plant(gm) (4.08), Number of seeds per plot (gm)(69.46), Biological

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yield per plant (g)(79.73), Harvest index(69.67) followed by T3 Panchagavya @ 7% for 8hrs producing number of leaves(18), length of leaf(cm)(11.2),No. of seeds per plant (gm) (3.71), Number of seeds per plot (gm)(63.05), Biological yield per plant (g)(73.56), Harvest index(65.10) which were highly significant at 5% level of significance.

**Keywords:** Spinach; organic priming; panchagavya; neem leaf extract; moringa leaf extract; seaweed liquid extract.

## 1. INTRODUCTION

Spinach (*Spinacia oleracea* L.) is an edible flowering plant in the family Amaranthaceae. It was long considered to be in the family Chenopodiaceae, but in 2003, that family was merged into the family Amaranthaceae in the order Caryophyllales. Within the family Amaranthaceae, spinach belongs to subfamily Chenopodioideae. Spinach is most probably a native of central and western Asia region. It was known in China as early as 647 AD. Spinach, swiss chard and garden beet has a chromosome number  $2n=2x=24$ , indicates their close relationship. Spinach is one of the most common leafy vegetables of tropical and subtropical regions. The popular spinach growing states include Uttar Pradesh, West Bengal, Maharashtra and Gujarat. However, spinach is not very popular in South India.

### 1.1 Area, Production and Productivity

Worldwide 26,688,150 tonnes of spinach is produced per year. China is the largest spinach producer in the world with 24,484,507 tonnes production volume per year.

Total production of vegetables in India around 1,84,394 MT (Production in '000 MT) over 10,259 ha. Of land. Per cent share of vegetable crops in Indian horticulture is reported around 59.2 per cent in last 2017-18 (Anonymous 2018). It is extraordinarily high in vitamin C and rich in Riboflavin. It is high yielding and slow to bolt, therefore suitable for all year cultivation. Plant produces stalks 65-75 days after sowing. Stalks and leaves are light green. Average Yield is 125q/ha of green leaves and average seed yield is 800kg-1 ton per hectare.

The mode of application of SLF (Seaweed Liquid Fertilizer) can be of any of the following methods. It can be Seed treatment (dipping of seeds in seaweed liquid manure before cultivation) or Soil treatment (treating soil with seaweed liquid manure). Seaweed extract is a natural organic fertilizer which promotes faster seed germination and is highly nutritious to plants. The Seaweed

extract contains regulators, plant growth hormones, carbohydrates, auxins, gibberellins and vitamins and helps to maintain soil fertility. It is effective and eco-friendly for sustainable agriculture.

## 2. MATERIALS AND METHODS

**Varietal features:** All green variety of spinach was developed by Indian Agricultural Research Institute (IARI). It produces tender leaves and gives 6-7 cuttings at 15-20 days interval. This variety has high adaptability area in Uttar Pradesh, Punjab, Chandigarh, Himachal Pradesh, Madhya Pradesh, Bihar, West Bengal, Maharashtra, Andhra Pradesh.

**Afield experiment details:** Pre-sowing seed treatment with Panchagavya and Leaf Extract of Moringa, Neem and Seaweed liquid was made to identify effect of seed treatments of different seed quality and yield parameters of spinach and to find out suitable seed treatment method for Spinach. The experiment was laid out in Randomized Block Design with 13 treatments including control which were replicated thrice in rabi 2021. The treatments are as follows, T0-Control, T1,T2,T3-Panchagavya @ 3,5 and 7%, T4,T5,T6- Neem Leaf Extract @ 3,5,7%, T7,T8,T9 – Moringa Leaf Extract @ 3,5,7%, T10,T11,T12 – Seaweed Extract @ 2,4,6% respectively. The spinach seeds were primed with above mentioned treatments with different concentrations. After treating seed were dried to initial moisture content at room temperature.

### 2.1 Preparation of Treatments

**Panchagavya:** Panchagavya is prepared from cow products viz. Cow milk (5L), ghee (2L), curd (2kg), cow urine (5L) and cow dung (5kg). These ingredients were mixed together along with 15kg of jaggery in a circular container. The mixture was added with 15L of water and kept as such for 30 days. Fermentation took place by making the mixture to a fine concentrate giving out the sweet odour. The fermented liquid was filtered through cotton and final volume of filtrate was made 1000 ml.

**Mode of action:** Biochemical Properties containing major nutrients like N,P,K and necessary micronutrients such as Indole acetic acid(IAA), Gibberellic acid which helps in Plant growth and health.

**Moringa leaf extract:** Fresh *M. olerifera* leaves will be air-dried before being processed into powder. The crude powders were kept at room temperature in paper bags. Moringa leaves powder was soaked in distilled water for 24 hours at room temperature with intermittent shaking to obtain stock moringa leaf extract.

To eliminate fiber debris, the mixture is filtered through four layers of cheesecloth, followed by Whatman No.1 filter paper.

**Mode of action:** Moringa leaf has sufficient amount of macro and micronutrients, plant-hormones, vital amino acids and vitamins that enhances the growth, improves yield and quality of the crop.

**Neem leaf extract:** For 1kg of green neem leaf is required. The leaves are soaked overnight in water. The next day the leaves are grounded and the extract is filtered.

**Mode of action:** Neem leaf has compounds like Azadiradione, nimbin, salanin and epoxyadiradione which when treated with seeds increases seed germination, seedling emergence and increases root-shoot ratio. Neem leaf extract also stimulates growth of microbes in root zone.

**Seaweed liquid extract:** Fresh marine algae are washed thoroughly to removes all epiphytes & sand particles with tap water. The seaweeds are dried for 3-5 days after dried seaweed to convert into powder form. Boiled for 45 to 60 minutes and filter by the muslin cloth. The extract is 100% concentration.

**Mode of action:** Seaweed has components such as Macro & micro elements, amino acids, vitamins, cytokinins, auxins and abscisic acid which improves the growth and crop yield, The seeds when treated with seaweed liquid imposes synchrony of radical emergence, increase growth rate and increases seed germination.

### 3. RESULTS AND DISCUSSION

The mean performance of field emergence value of 36.58%. Significantly maximum highest

percentage of field emergence at 4DAS (42.22%) was recorded T10- Seaweed extract -2%. The mean performance of field emergence with mean value of 64.74%. Significantly maximum highest percentage of field emergence at 7DAS (76.11%) was recorded T10- Seaweed extract -2%. The mean performance of field emergence with mean value of 84.66 % . was recorded highest of 91.11 % with the treatments T10 Seaweed Liquid Extract @ 2% 8.

The mean performance of plant height at 20DAS with mean value of 14.27 cm. Significantly maximum recorded highest of 18.8 cm with the treatments T10 Seaweed Liquid Extract @ 2% 8. The mean performance of plant height at 40DAS with mean value of 17.75 cm. Significantly maximum recorded highest of 22.4 cm with the treatments T10 Seaweed Liquid Extract @ 2% 8. The mean performance of plant height at 60DAS with mean value of 27.22 cm. Significantly maximum recorded highest of 32.2 cm with the treatments T10 Seaweed Liquid Extract @ 2% 8 hrs.

Significantly minimum Days to 50% flowering (83 %) was recorded T9- Moringa leaf Extract -5% and it was followed by Minimum days to 50% flowering was recorded by T0 – Control (67%).

The mean performance of Days to maturity with mean value of 118.70 The treatment T10 Seaweed Liquid Extract @ 2% 8 hrs recorded the minimum number of days required for days to maturity is 110.

The mean performance of Leaf length (cm) with mean value of 10.61 cm. Maximum length of leaves were recorded with the treatments T10 Seaweed Liquid Extract @ 2% 8 hrs (12.8).

The mean performance of number of leaves per with mean value of 15.3. Significantly Maximum number of leaves were recorded with the treatments T10 Seaweed Liquid Extract @ 2% for 8 hrs (19).

The mean performance of number of seeds per plant with mean value of 3.52. Significantly Maximum seed yield per plant (gm) were recorded with the treatments T10 Seaweed Liquid Extract @ 2% for 8 hrs (4 gm). The mean performance seed yield per plot (g) with mean value of 59.92 g. Significantly Maximum seed yield per plot (gm) were recorded with the treatments T10 Seaweed Liquid Extract @ 2% for 8 hrs (69.4 gm).

**Table 1. Analysis of variance for different parameters in spinach (*Spinacia oleracea* L)**

S. No	Treatments	Mean sum of square		
		Replication (d. f = 2)	Treatment (d. f. = 12)	Error (d. f. = 24)
1	Field emergence (%) at 4DAS	177.62	54.46*	8.83
2	Field emergence (%) at 7DAS	686.88	54.36*	8.93
3	Field emergence (%) at 10DAS	174.32	326.52*	14.25
4	Plant height (cm) at 20DAS	109.17	11.07*	0.30
5	Plant height (cm) at 40DAS	15.58	11.02*	0.35
6	Plant height (cm) at 60DAS	69.77	11.07*	0.30
7	Days to 50 % flowering	283.10	7.92*	3.52
8	Days to maturity	326.26	22.7*	3.67
9	Number of leaves per plant	11.12	1.60*	0.25
10	Leaf length(cm)	6.88	2.19*	0.17
11	Seed yield per plant (g)	0.05	0.18*	0.01
12	Seed yield per plot (g)	269.90	50.95*	2.20
13	Biological yield per plant (g)	456.54	97.33*	18.43
14	Harvest index	267.37	78.40*	19.46

\*CD 5% level of significance

**Table 2. Pre harvest for effect of panchagavya and leaf extracts of moringa, neem and seaweed on growth, yield and yield attributing traits of spinach (*Spinacia oleracea* L)**

Treatments	Field emergence (%) at 4DAS	Field emergence (%) at 7DAS	Field emergence (%) at 10DAS	Plant height at 20DAS	Plant height at 40DAS	Plant height at 60DAS	Days to 50% Flowering	Days to maturity	Leaf length	Number of leaves/plant
T0-Control	30.56	52.22	77.78	10	14.2	19.7	67	124	9.68	14
T1-Panchagavya-3%	35	60.56	82.22	12.7	16.7	26.5	70	114	10.4	16
T2- Panchagavya -5%	35.56	65	81.11	12.8	16.8	26.8	75	118	10.2	16
T3- Panchagavya -7%	39.44	64.44	86.11	16.9	20.4	30.2	67	116	11.68	18
T4- Neem Leaf Extract 3%	33.89	62.78	86.67	14.1	17.1	27.5	68	122	10.3	16
T5- Neem Leaf Extract 5%	37.22	60	82.78	12.1	18.1	27.1	75	120	10.34	16
T6- Neem Leaf Extract -%	37.78	68.89	85.56	16.2	20.2	29.4	67	118	11.28	18
T7- Moringa leaf Extract -7%	36.67	68.33	86.67	15.2	17.5	27.1	83	122	10.39	16
T8- Moringa leaf Extract -3%	34.44	62.22	83.89	13.4	15.6	26.6	80	122	10.27	18
T9- Moringa leaf Extract -5%	33.89	65	83.33	13.5	15.6	26.5	83	118	9.84	18
T10- Seaweed extract -2%	42.22	76.11	91.11	18.8	22.4	32.2	64	110	12.85	19
T11- Seaweed extract -4%	38.89	67.78	87.22	15.3	18.6	27.6	76	120	10.07	16

Treatments	Field emergence (%) at 4DAS	Field emergence (%) at 7DAS	Field emergence (%) at 10DAS	Plant height at 20DAS	Plant height at 40DAS	Plant height at 60DAS	Days to 50% Flowering	Days to maturity	Leaf length	Number of leaves/plant
T12- Seaweed extract -6%	39.93	68.33	86.11	14.5	17.6	26.6	78	120	10.57	16
Mean	36.58	64.74	84.66	14.27	17.75	27.22	73.31	118.70	10.61	15.3
CV	9.27	5.93	4.56	3.65	3.41	2.44	3.08	1.57	3.85	4.02
SEm	1.72	1.72	2.18	0.32	0.32	0.32	1.08	1.11	0.23	0.29
CD at 5%	5.01	5.01	6.36	0.83	0.89	0.94	3.16	3.23	0.69	0.84
<b>Minimum</b>	<b>30.56</b>	<b>52.22</b>	<b>77.88</b>	<b>10</b>	<b>14.2</b>	<b>19.7</b>	<b>67</b>	<b>124</b>	<b>9.68</b>	<b>14</b>
<b>Maximum</b>	<b>42.22</b>	<b>76.11</b>	<b>91.11</b>	<b>18.8</b>	<b>22.4</b>	<b>32.2</b>	<b>83</b>	<b>110</b>	<b>12.85</b>	<b>19</b>

**Table 3. Post harvesting observation effect of panchagavya and leaf extracts of moringa, neem and seaweed on growth, yield and yield attributing traits of spinach (*Spinacia oleracea* L)**

Treatments	Seed yield per plant(g)	Seed yield per plot(g)	Biological yield (g)	Harvest index (%)
T0-Control	3.23	54.97	65.2	57.4
T1-Panchagavya-3%	3.37	57.34	70.46	56.1
T2- Panchagavya -5%	3.35	57.15	70.13	55
T3- Panchagavya -7%	3.93	66.87	73.56	65.1
T4- Neem Leaf Extract 3%	3.47	59.19	65.1	61.5
T5- Neem Leaf Extract 5%	3.49	59.54	74	59.33
T6- Neem Leaf Extract -%	3.71	63.05	66.26	66.2
T7- Moringa leaf Extract -7%	3.49	58.7	68.83	57.03
T8- Moringa leaf Extract -3%	3.41	58.19	72.1	53.07
T9- Moringa leaf Extract -5%	4.08	57.69	73.66	53.4
T10- Seaweed extract -2%	3.39	69.46	79.73	69.67
T11- Seaweed extract -4%	3.47	57.66	77.66	66.37
T12- Seaweed extract -6%	3.52	59.15	76.06	68
Mean	3.53	59.92	71.75	60.63
CV	2.45	2.48	6.22	7.9
SEm	0.05	0.86	2.48	2.55
CD at 5%	0.15	2.5	7.23	7.43
<b>Minimum</b>	<b>3.23</b>	<b>54.97</b>	<b>65.2</b>	<b>57.4</b>
<b>Maximum</b>	<b>4.08</b>	<b>69.46</b>	<b>79.73</b>	<b>69.67</b>

The mean performance Biological yield (g) with mean value of 71.75 g. Significantly Maximum biological yield were recorded with the treatments T10 Seaweed Liquid Extract @ 2% for 8 hrs (79.7).

The mean performance Harvest index (%) with mean value of 60.63 %. Significantly Maximum harvest index were recorded with the treatments T10 Seaweed Liquid Extract @ 2% 8 hrs (69.6) followed the lowest in T0 – control (57.4), respectively.

“The germination of the seed is a complex process and is defined by several authors in different ways” [1]. “Seed treatment of seaweed sap at 15% concentration of either Kappaphycus or Gracilara sap significantly increased the germination in wheat. But, when the concentration is either reduced to 2.5% or increased to 20%, significant reduction in the germination was noticed” [2]. “In the early stages of germination,  $\alpha$ -amylases are less active and the energy generated for the plant usually comes from the hydrolysis of sucrose and maltose by  $\beta$ -amylases” Palmiano et al. [3]. “The major phyto hormones recognized in seaweed extracts are auxins, cytokinin, gibberellins, abscisic acid, ethylene and auxins, which are accountable for elongation of plant tissue growth and apical dominance, cell division” Thomas, M et al. [4]. “Cytokinins involved in the activation of cell divisions responsible for plant growth. treatment with seaweed extract recorded the maximum plant height in *Petunia Elansary*”, H. O. et al. [5]. Domínguez, F et al. [6] revealed “these enzymes allow for the mobilization of storage material of the endosperm, which helps to support the early growth of seedlings. Once the process is completed, scutellum and aleurone layer cells undergo programmed cell death and their content is used to support the growth of the germinated embryo”. “The major phyto hormones recognized in seaweed extracts are auxins, cytokinin, gibberellins, abscisic acid, ethylene and auxins, which are accountable for elongation of plant tissue growth and apical dominance, cell division” Thomas, M et al. [4]. “Cytokinins involved in the activation of cell divisions responsible for plant growth. treatment with seaweed extract recorded the maximum plant height in *Petunia Elansary*”, H. O. et al. [5]. Mc Fadden, G.I et al. [7] during germination,  $\beta$ glucanases are synthesized primarily in the aleurone and scutellum and are secreted by endosperm cells. The existence of not only plant growth regulators such as cytokines, gibberellins

but also trace minerals, vitamin supplements, essential amino acids in aquatic vegetation has strengthened yield potential as well as quality, likely having a positive impact on either dramatically lessened fall of blossoms and buds or steadily enlarged dimension of florals. Seaweed liquid extract of *Sargassum crassifolium* was rich in potassium macronutrients that contribute to enhancing the number of flowers in the tomato plant Sánchez-Blanco et al. (2019). “Its changes were reported on improving crop biomass and also intensified shoot fresh and dry weight of plants” [8]. “The photosynthetic pigment condition of the crops was reinforced with a foliar application of macroalgae supplement Each growth and structure changes in phenols, flavones, and tannins are due to the stimulating effect of seaweed extract” Ahmad, S., Ullah, F. [9]. “Due to increased plant height, number of pods plant-1, number of grains plant-1, number of branches, and improved nutrient uptake by plant, 15% seaweed extract from *Kappaphycus alvarezii* resulted in a 57% increase in grain yield in soybean” [10]. “It was confirmed that applying 0.6% concentrations of *Gracilaria dendroides*, and *Ulva lactuca* to sunflower resulted in higher oil content of 34.05 and 30.55%, respectively” [11] and (Salem et al. 2011).

#### 4. CONCLUSION

Seed treatment can improve seed germination, seedling emergence and plant Vigour, stand establishment and total yield, helping to ensure the crop or pasture is on its way to reaching its full genetic potential. Increases the strike rate for faster germination and uniform emergence.

It is concluded from the present study that the seeds of Spinach variety – All Green treated with Seaweed Liquid Extract@ 2% for 8hrs was recorded the highest than the other treatments mentioned.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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