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

ABSTRACT

The present investigation was carried out for ***"Effect of Panchagavya and Leaf Extracts of Moringa, Neem and Seaweed on Growth, Yield and Yield Attributing Traits of Spinach (****Spinacia oleraceaL****)".*** *For this purpose, 13 treatments including control on spinach seeds variety- (All green)were used to study under filed conditions during Rabi, 2021-22. Field experiment was laid out in Randomized Block Design (RBD) with three replications respectivelyduring Rabi 2021-22.Analysis for the data based on ANNOVA and mean performance in field experiment revealed significance mean sum of squares due to seed treatments for all the characters under study.In order to response different method of seed treatment to specific spinach crop and they were evaluated by screening a range of duration and concentration Viz* T_0*-Control, T1-Panchgavya-3% for 8Hrs, T2-Panchagavya-5% for 8Hrs, T3-Panchagavya-7% for 8Hrs, T4-Neem leaf extract-1% for 8hrs, T5-Neem leaf extract -3% for 8hrs, T6-Neem leaf extract -5% for 8hrs, T7-Moringa leaf extract-1% for 8hrs, T8-Moringa leaf extract -3% for 8hrs, T8-Moringa leaf extract -5% for 8hrs, T10-Seaweed liquid extract -2% for 8 hrs, T11-Sea weed Liquid extract -4% for 8hrs, T12-Sea weed liquid extract -6% for 8hrs.To find out Influence of different seed treatment on organic priming and leaf extract on growth, yield and yield attributing traits of spinachshowed that significant treatment Field emergence(%), Plant height (cm), Days to 50%flowering, Days to maturity, Number of leaves perplant, Leaf length(cm), Seed yield per plant(g),Seed yield per plot (g), Biological yield(g),Harvestindex.It ~~is~~ was 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 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 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)*

Key words: Spinach,Organic priming, Panchagavya, Neem leaf extract, Moringa Leaf extract,Seaweed liquid extract,RBD (Randomized Block Design)

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Introduction

Spinach (*Spinacia oleracea* L.) is an edible flowering plant in the family Amaranthaceae. It waslong 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, indicaingtes their close relationship.Leaves of this crop might have been first used in Bengal and hence it is known as *Beta vulgaris var. bengalensis*. Spinach is one of the most common leafy vegetables of tropical and subtropical regions. The popular spinach

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growing states include Uttar Pradesh, West Bengal, Maharashtra and Gujarat. However, spinach is not very popular in South India.

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 was around 1, 84, 394 MT (Production in '000 MT) over 10, 259 ha. o~~O~~f land. Per cent share of vegetable crops in Indian horticulture is reported around 59.2 per cent in last 2017-18 (**Anonymous 2018).**The mode of application of SLF (Seaweed Liquid Fertilizer) can be of any of the following methods. It can be ~~Seed~~ seed treatment (dipping of seeds in seaweed liquid manure before cultivation) or ~~Soil~~ 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 cost effective and eco-friendly for sustainable agriculture

MATERIALS AND METHODS

Varietal features: All green variety of spinach has high adaptability area in Uttar Pradesh, Punjab, Chandigarh, Himachal Pradesh, Madhya Pradesh, Bihar, West Bengal, Maharashtra, Andhra Pradesh. It is extraordinarily high in vitamin C and rich in Riboflavin. It is also high yielding and slow to bolt, therefore suitable for ~~all year~~year round 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.

Afield experiment details: Pre-sowing seed treatment with Panchagavya and ~~Leaf~~ leaf Extract of Moringa, Neem and Seaweed liquid Extract on Yield and Yield attributing traits in Spinach(*Spinacia oleracea L.)* Var. "All Green" 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

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were dried to initial moisture content at room temperature.

Methodology:-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 1000ml.

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.

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.

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. The powder was mixed with distilled water in ratio of 1:20 (w/v). Boiled for 45 to 60 minutes and filter by the muslin cloth. The extract is 100% concentration.

RESULTS AND DISCUSSION

An investigation was carried out **"Effect of Panchagavya and Leaf Extracts of Moringa, Neem and Seaweed on Growth, Yield and Yield Attributing Traits of Spinach (***Spinacia oleracea*L**)"**Growthandyieldparametersincludefieldemergencepercentage, Plant height(cm),days to 50% flowering, days to maturity, number of leaves per plant, leaf length(cm), seed yield per plant(g), seed yield per plot(g), biological yield (g) and harvest index (%). The silent found of the study are summarizedbelow. The mean performance of field emergence ranged from 30.56 % to 42.22 % with mean value of 36.58%.Significantly ~~maximum~~ highest percentage of field emergence at 4DAS (42.22%) was recorded in T10- Seaweed extract -2% and it was followed by T12- Seaweed extract -6%, T3- Panchagavya -7% (39.44 %), T11- Seaweed extract -4% (38.89%), and T5- Neem Leaf Extract 5% (37.78 %). Minimum field emergence was recorded by T0 – Control (30.56 %). The mean performance of field emergence ranged from 52.22 % to 76.11 %

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with mean value of 64.74%.Significantly maximum highest percentage of field emergence at 7DAS (76.11%) was recorded T10- Seaweed extract -2% and it was followed by T6- Neem Leaf Extract -7%(68.89%), T12- Seaweed extract -6% (68.33 %), T12- Seaweed extract -6% (68.33 %), and T11- Seaweed extract -4% (67.78 %). Minimum field emergence was recorded by T0 – Control (52.22 %). The mean performance of field emergence ranged from 77.78 % to 91.11 % with mean value of 84.66 %. was recorded highest of 91.11 % with the treatments T10 Seaweed Liquid Extract @ 2% 8 hrs followed by 86.11 % with T3 Panchagavya@7 % for 8 hrs and the lowest in T0 – control with 77.78% respectively. The mean performance of plant height at 20DAS ranged from 10 cm to 18.8 cm with mean value of 14.27 cm. Significantly maximum recorded highest of 18.8 cm with the treatments T10 Seaweed Liquid Extract @ 2% 8 hrs followed by of T3 Panchagavya @7 % for8 hrs 16.9 cm and the lowest in T0 – control with 10.0 cm respectively. The mean performance of plant height at 40DAS ranged from 14.2 cm to 22.4 cm with mean value of 17.75 cm. Significantly maximum recorded highest of 22.4 cm with the treatments T10 Seaweed Liquid Extract @ 2% 8 hrs followed by of T3 Panchagavya @7 % for8 hrs 20.4 cm T11- Seaweed extract -4%(18.6 cm) , T5- Neem Leaf Extract 5% (18.1cm) and the lowest in T0 – control with 14.2 cm respectively. The mean performance of plant height at 60DAS ranged from 19.7 cm to 32.2 cm 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 followed by of T3 Panchagavya @7 % for8 hrs 30.2 cm , T6- Neem Leaf Extract -7% (29.4 cm) , T11- Seaweed extract -4% (27.1cm) and the lowest in T0 – control with 19.7 cm respectively. Significantly minimum Days to 50% flowering (83 %) was recorded T9- Moringa leaf Extract -5%and it was followed by T8- Moringa leaf Extract -3% for 8hrs (80%), T3- Panchagavya -7% for (8hrs) (75%), Maximum days to 50% flowering was recorded by T0 – Control (67%). ThemeanperformanceofDays to maturityrangedfrom 94to 114.7 withmeanvalueof118.70 The treatment T10 Seaweed Liquid Extract @ 2% 8 hrs recorded the minimum number of days required for days to maturity is 110 DAS followed by T3 Panchagavya @ 7 % for 8 hrs 116DAS, T9- Moringa leaf Extract -5% for 8hrs is118DAS and maximum days recorded with control 124 respectively. ThemeanperformanceofLeaf length (cm) rangedfrom 9.68 cm to 12.85 cm withmeanvalueof10.61 cm.Maximum length of leaves were recorded with the treatments T10 Seaweed Liquid Extract @ 2% 8 hrs (12.8) followed by T3 Panchagavya @ 7% for 8 hrs(11.6), T6- Neem Leaf Extract -7% for 8 hrs (11.2 cm), T12- Seaweed extract -6% for 8 hrs (10.57 cm) and the lowest in T0 – control (9.68

cm) respectively. The mean performance of number of leaves per plant ranged from 14 to 19 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) followed by T3 Panchagavya @ 7% 8 hrs(18), T7- Moringa leaf Extract -7% for 8 hrs (18) and the lowest in T0 – control (14), respectively. Themeanperformanceofnumber of seeds per plant rangedfrom 82.15to119.87 withmeanvalue of92.75. Significantly maximum Number of seeds per plant (119.87) was recorded T6-Beejamrutha-5% for 8hrs and it was followed by T9-Jeevamrutha-5% (8hrs) (112.90), T3-Neem oil-7% (86.16), T12-Thiram-7% (94.25) Maximum number of seeds per plant was recorded by T0 – Control (82.15). Themeanperformanceofnumber of seeds per plant rangedfrom 3.23to4.08 withmeanvalue of3.52. Significantly Maximum seed yield per plant (gm) were recorded with the treatments T10 Seaweed Liquid Extract @ 2% for 8 hrs (4gm) followed by T3 Panchagavya @ 7% for 8 hrs(3.7gm) T9- Moringa leaf Extract -5% for 8 hrs (3.70g) and the lowest in T0 – control (3.2gm), respectively. Themeanperformanceseed yield per plot (g) rangedfrom 54.97 g to69.46 g withmeanvalue of59.92 g. Significantly Maximum seed yield per plot(gm) were recorded with the treatments T10 Seaweed Liquid Extract @ 2% for 8 hrs (69.4gm) followed by T3 Panchagavya @ 7% for 8 hrs (66.87 gm), T6- Neem Leaf Extract -7% for 8 hrs (63.05 g),T5- Neem Leaf Extract 5% for 8hrs (59.54 g) and the lowest in T0 – control (54.9gm), respectively. ThemeanperformanceBiological yield (g) rangedfrom 65.2 g to 79.73 g withmeanvalue of71.75 g. Significantly Maximum biological yield were recorded with the treatments T10 Seaweed Liquid Extract @ 2% for 8 hrs (79.7) followed by T11- Seaweed extract -4% for 8 hrs (77.6) , T5- Neem Leaf Extract 5% for 8hrs (74), T3 Panchagavya @ 7% for 8 hrs (73.5) and the lowest in T0 – control (65.2), respectively. ThemeanperformanceHarvest index (%) rangedfrom 57.4 % to 69.67 % withmeanvalue of60.63 %. Significantly Maximum harvest index were recorded with the treatments T10 Seaweed Liquid Extract @ 2% 8 hrs (69.6) followed by T12- Seaweed extract -6% for 8 hrs(68) ,T3 Panchagavya @ 7% 8 hrs (65.1) and 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 (Higashiyama *et al.,* 2003).Seedtreatment of seaweed sap at 15% concentration of either Kappaphyccus 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 (Dilvarnaik*et al.,* 2017).In the early stages of germination, α-

amylases are less active and the energy generated for the plant usually comes from the hydrolysis of sucrose and maltose by β-amylases Palmiano*et al.*, (1975). The major phytohormones 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.*,(2013). Cytokininis involved in the activation of cell divisions responsible for plant growth. treatment with seaweed extract recorded the maximum plant height in PetuniaElansary, H. O. *et al.*,(2017).Domínguez, F *et al.*,*(*2014) 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 phytohormones 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.*,(2013).Cytokininis involved in the activation of cell divisions responsible for plant growth. treatment with seaweed extract recorded the maximum plant height in PetuniaElansary, H. O. *et al.*,(2017).McFadden, G.I *et al.*,(1988) During germination, βglucanases 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 plantSánchez-Blanco*et al.*,(2019).Its changes were reported on improving crop biomass and also intensified shoot fresh and dry weight of plants (Luan P e*t al.*,2019).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., (2016).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 Kappaphycusalvarezii resulted in a 57% increase in grain yield in soybean (Rathore *et al.,* 2009).It was confirmed that applying 0.6% concentrations of *Gracilariadendroides*, and *Ulva lactuca* to sunflower resulted in higher oil content of 34.05 and 30.55%, respectively (Hannan *et al.,* 2011 and Salem *et al.,* 2011).

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CONCLUSION

Seed treatment can improve seed germination, seedling emergence, plant vigour, stand establishment and total yield, helping to ensure the crop or pasture is on its way to reaching its full genetic potential.Designed to improve the beginning stages of plant life which may result in the opportunity of better plant health and improved yields. 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 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 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)

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Table :01-ANOVA for 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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		Mean sum of square		
S.No	Treatments	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 no : 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
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
Minimum	**30.56**	**52.22**	**77.88**	**10**	**14.2**	**19.7**	**67**	**124**	**9.68**	**14**
Maximum	**42.22**	**76.11**	**91.11**	**18.8**	**22.4**	**32.2**	**83**	**110**	**12.85**	**19**

Table no : 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
Minimum	**3.23**	**54.97**	**65.2**	**57.4**
Maximum	**4.08**	**69.46**	**79.73**	**69.67**

Comment [SC28]: Better to show the yield data in graph

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