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RESEARCH ARTICLE

EFFECT OF VARIOUS ORGANIC FERTILIZERS ON SEEDLING HEALTH AND VIGOUR OF DIFFERENT VARIETIES OF CUCUMBER IN RAUTAHAT CONDITION

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ABSTRACT

Cucumber (Cucumis sativus L.) is one of the most popular vegetable crop of cucurbitaceae family. The experiment was laid out as 4×2 factorial Completely Randomized Block Design (RCBD) with three replications. The treatment consisted of two cucumber varieties (Dynasty and Malini) and different types of Organic Fertilizers namely (Peat moss, Vermicompost, Trichocompost and bare soil). Seedlings were raised on plastic pots inside a plastic tunnel with respective treatment and randomization of replication was done. Data analaysis was done using Duncan's Multiple Range Test (DMRT) using GENSTAT. The result of the experiment indicated that trichocompost had significantly higher germination index(23.41) being statistically at par with peatmoss(22.76), greater number of leaves(3.9), dry root weight(0.8857g), dry shoot weight(1.647g), and lowest damping off incidence at 7DAS(1.567%), 11DAS(3.75%) and 15 DAS(4.58%). Peatmoss had higher germination (92.64%) being statistically at par with trichocompost (91.74%), larger leaf width(6.152cm) being at par with vermicompost(6.160cm) and trichocompost(6.023cm), higher fresh weight (23.67g) being at par with vermicomost(22g) and trichocompost(21.67g), higher vigor index(2320) and longer shoot length(7.980cm) being at par with trichocompost(7.853cm). Similarly control had higher root to shoot length ratio(2.977). Also, variety malini was found to be superior in all observed parameters except damping off. Thus it is suggested to use malini as a variety and trichocompost as a potting media to raise seedlings of cucumber in rautahat condition for better results.

KEYWORDS

Organic Fertilizer, Peatmoss, Vermicompost, Trichocompost, Variety.

1. INTRODUCTION

Cucumis sativus L. one of the most popular crop plant of cucurbitaceae family (about 750 species) is used as an important vegetable (Malepszy and Niemirowicz-Szczytt, 1991). It is often eaten as a vegetable but scientifically considered as a fruit as they contain enclosed seeds and develop from a flower (FDA, 2016). Cucumbers are summer season plants and grow best between 65°F to 75°F. This crop cannot tolerate prolonged exposure to temperatures below 55°F or above 90°F (FDA, 2016). For the proper growth and development of plant, the daytime temperatures should be 27-30^0 C and soil temperature should be at least 18^{0}C (Pishgar-Komleh et al., 2013). The new approaches to the use of organic amendments in farming have become an excellent source of plant available nutrients and also have proven to be effective means of improving soil structure, enhancing soil fertility (Arancon et al., 2004).

Various organic materials have been recognized as soil amendments and disease controllers, including the control of brown spot disease and escalation of bacterial numbers by rice bran and the increase in plant growth and reduction of nematode population by oil cakes (Osunlaja, 1989; Khan and Saxena, 1997). Organic fertilizer have a positive effect to soil microbial community with increasing number of aerobic bacteria and actinomycetes (Hanada, 1991). Organic fertilizers like vermicompost, trichocompost and peatmoss provide a favourable and eco-friendly environment for the healthy growth and development of vegetable seedlings (Wilson and Carlile, 1989; Edwards and Burrows, 1988; Gravel et al., 2007; Raviv et al., 1986; Abad et al., 2002). Damping-off diseases in seedling preparation which are primarily caused by the ubiquitous pathogen Pythium ultimum Trow and Rhizoctonia solani has been improved by introduction of improved soil media. An experiment showed the efficiency of two antagonists glaucodium and trichoderma to contol several diseases including damping off (Papavizas, 1985).

The use of inorganic fertilizers are rather expensive for low income, small-scale farmers, and are often associated with increased acidity and nutrient imbalance (Ayoola and Makinde, 2009). Hence organic fertilizers can be an effective alternative to chemical fertilizers as they contain high levels of nutrients and organic matter required for healthy growth of seedlings. This technique of potting amendment also facilitates the healthy growth of cucumber seedlings even under adverse environment condition as the pots can be easily moved in safe places. The major objective of this experiment was to evaluate the effect of organic fertilizers as potting amendment on seed germination, vigor and seedling quality of two cucumber varieties. Varieties of cucumber Malini and dynasty was purposively selected for the experimental trial which was the recommended domain for our experimental site i.e. terai region (Krishna et al., 2017; AICC, 2018).

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2. METHODS AND METHODOLOGY

2.1 Site Selection

The experiment was conducted in Mohammadpur -5, Rautahat which is the working area of Prime Minister Agriculture Modernization Project. Rautahat district has been identified as potential district for vegetable production and as per PMAM Project guidelines, 16 wards of Garuda Municipaity has been identified as vegetable zone. It lies in terai region of Province No. 2 including sixteen municipalities and 2 rural municipality with an elevation of 300 m from mean sea level. It is situated in 27°00'00.0"N latitude and 85°20'00.0" E longitude, covering an area of 1,126 km^2.

Figure 1: Location map of Garuda, Rautahat

2.2 Weather Condition

The site where experimental trial was done lies in the sub-tropical zone of Nepal. It is characterized by three distinct seasons namely, rainy monsoon (June – October), cool winter (November – February), and hot summer (March – May). Experimental trial was conducted during the month of 29th of January to 20th of February. Increased amount of rainfall, relative humidity, maximum and minimum temperature were observed during the experimental period from January to February.

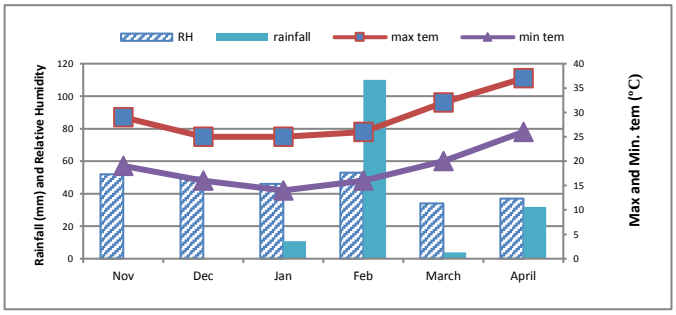

Figure 2: Maximum temperature, minimum temperature, Relative Humidity (RH) and rainfall at 30 days interval during the growing season at Garuda, Rautahat 2075/76

2.3 Experimental Design

The experiment was laid out as 4×2 factorial Completely Randomized Block Design (RCBD) with 3 replications. The first factor consisted of four types of Organic Fertilizers namely; Peat moss, Vermicompost, Trichocompost and soil as a control and second factor consists of two Cucumber varieties namely Dynasty and Malini.

2.4 Experimental Procedure

Seedlings were raised on plastic pots measuring 15 cm x 12cm x 7 cm (1260 cm^3) inside a plastic tunnel on 15th of Magh, 2075. 36 plastic pots were used for each of treatment and thus 288 pots for each replication. One seed were sown in each pot.

2.5 Germination%

The criterion used for seed germination was taken as emergence of 2 mm radicle at the time of observation (Odoemena, 1988). Germination counts were recorded until 23 days after sowing. The germination percentage of the seeds was finally determined for each of the treatments (Abdul-Baki and Anderson, 1973).

$$\text{Germination\%} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds planted}} \times 100$$

2.6 Germination Index

Germination index was calculated by using the formula;
Germination Index =

$$\frac{\text{No. of germinated seeds } (1^{st} \text{ count})}{\text{Days to } 1^{st} \text{ count}} + \frac{\text{No. of germinated seeds } (2^{nd} \text{ count})}{\text{Days to } 2^{nd} \text{ count}} + \frac{\text{No. of germinated seeds } (3^{rd} \text{ count})}{\text{Days to } 3^{rd} \text{ count}}$$

2.7 Vigour Index

For determination of seedling vigour, 5 seedlings were randomly selected from each treatment and their individual shoot and root length were measured. The vigour index of the seedlings was determined by following the formula (Abdul-Baki and Anderson, 1973).

Vigor index = [mean of root length (cm) + mean of shoot length (cm)] × percentage of seed germination (%)

2.8 Fresh weight

After 23 days, the growth parameters were estimated after uprooting and cleaning the seedlings. Different parameters were recorded with appropriate measures. The fresh weight (in grams per 5 seedlings) was measured with a digital weighing balance.

2.9 Dry weight

Dry sample was obtained after oven drying the fresh weight of sample in an oven under 105 ^{0}C for 24 hrs. Dry weight was measured (in grams per 5 seedlings) with a digital weighing balance.

2.10 Root Length

Length of roots was measured after uprooting and cleaning the seedlings. Root length of five seedlings was measured and average was taken.

2.11 Shoot Length

Shoot length of five seedlings was measured and average was taken. Length was measured using scale just above the crown region.

2.12 Disease Incidence

Damping off disease incidence of infected seedlings was recorded and calculated by using the following formula,
% Disease incidence = (Number of infected seedling) x 100/Number of inspected seedling.

2.13 Data analysis

All the recorded were arranged systematically on the basis of various observed parameters. Different statistical tools GENSTAT, EXCEL and MSWORD were used for the analysis of variance and tabulation.

3. RESULTS

3.1 Germination%, Germination Index, No. of Leaves and leaf width

For organic fertilizers Germination%, germination index, number of leaves and leaf width were all found to be significantly different ($P<0.01$). Germination% was higher in peatmoss (92.64%) than vermicompost (84.54%) and control (70.00%) but at par with trichocompost (91.74%). Similarly, peat moss had higher germination index (22.76) than vermicompost (19.72) followed by control (16.36) but at par with trichocompost (23.41). Maximum number of leaves was found in trichocompost (3.9) which was at par with vermicompost (3.767) and followed by peatmoss (3.7) while being lowest in control (3.233). Larger leaf width was found in vermicompost (6.160cm) than control(3.7cm) but at par with peatmoss (6.152cm) and trichocompost (6.023cm). For Varieties, germination% ($P<0.05$) and Leaf width ($P<0.01$) were significantly different, and non-significant for germination index and number of leaves. Malini variety (86.96%) had more germination than dynasty (82.50%). The germination index of malini variety was higher than dynasty variety. Variety malini (5.791cm) had larger leaf width than dynasty (5.227cm).

Table 1: Influence of organic fertilizers and variety on germination%, germination index, number of leaves and leaf width

Treatments	Germination%	Germination Index	No. of Leaves	Leaf Width
Organic Fertilizers				
Peatmoss	92.64[a] (9.623[a])	22.76[a]	3.700[b]	6.152[a]
Control	70.00[c] (8.359[c])	16.36[c]	3.233[c]	3.700[b]
Vermicompost	84.54[b] (9194[b])	19.72[b]	3.767[ab]	6.160[a]
Trichocompost	91.74[a] (9.578[a])	23.41[a]	3.900[a]	6.023[a]
SEm(±)	2.868 (0.0639)	0.528	0.0546	0.1172
LSD(=0.05)	3.552 (0.1940)	1.603	0.1655	0.3555
F test	1%	1%	1%	1%
Varieties				
Malini	86.96[a] (9.316[a])	21.40	3.617	5.791[a]
Dynasty	82.50[b] (9.061[b])	19.73	3.683	5.227[b]
SEm(±)	0.828 (0.0452)	0.374	0.0386	0.0829
LSD (=0.05)	2.511 (0.1371)	1.133	NS	0.2514
F test	5%	NS	NS	1%
CV%	3.4 (1.7)	6.3	3.7	5.2
Grand Mean	84.73 (9.188)	20.56	3.65	5.509

Note: CV= Coefficient of Variance, SEm=Standard error of means, LSD= Least Significant Difference. Treatments means followed by the common letter (s) are not significantly different from each other based on DMRT at 5% level of significance.

2.1 Fresh wt., Dry root wt, Dry Shoot Wt, Vigor Index

For organic fertilizers; Fresh weight, dry root weight, dry shoot weight and leaf width were all found to be significantly different (P<0.01). Fresh weight of seedlings was found to be higher in peatmoss (23.67g) than control (11.33g) but at par with vermicompost (22.00g) and trichocompost (21.67g). Dry root weight of trichocompost (0.8857g) was found greater followed by peatmoss (0.8152g), vermicompost (0.5532g) and control (0.4264g) respectively. Dry shoot weight of trichocompost (1.647g) was found higher followed by peatmoss (1.608g), vermicompost (1.346g) and control (0.857g) respectively. Vigour Index of peatmoss (2320) was found to be higher followed by trichocompost (2118), vermicompost (1822) and control (1391) respectively. For varieties dry root weight, dry shoot weight and leaf width were found to be significantly different (P<0.01), and nonsignificant for fresh weight. Variety Malini (21.08g) had greater fresh weight than dynasty (18.25g). Variety Malini had more dry root weight than Dynasty. Variety Malini (1.4424g) had larger dry shoot weight than Dynasty (1.2864g). Variety Malini(2017g) had greater vigour index than Dynasty(1809g).

Table 2: Influence of organic fertilizers and variety on fresh weight, dry root weight, dry shoot weight and vigor index

Treatments	Fresh wt	Dry root wt	Dry Shoot Wt	Vigor Index
Organic Fertilizers				
Peatmoss	23.67[a]	0.8152[b]	1.608[b]	2320[a]
Control	11.33[b]	0.4264[d]	0.857[d]	1391[d]
Vermicompost	22.00[a]	0.5532[c]	1.346[c]	1822[c]
Trichocompost	21.67[a]	0.8857[a]	1.647[a]	2118[b]
SEm(±)	0.834	0.00898	0.01061	43.8
LSD(=0.05)	2.529	0.02724	0.03219	132.8
F test	1%	1%	1%	1%
Varieties				
Malini	21.08[a]	0.7237[a]	1.4424[a]	2017[a]
Dynasty	18.25[b]	0.6166[b]	1.2864[b]	1809[b]
SEm(±)	0.590	0.00635	0.0075	31
LSD (=0.05)	1.789	0.01926	0.02276	93.9
F test	NS	1%	1%	1%
CV%	10.4	3.3	1.9	5.6
Grand Mean	19.67	0.6701	1.3644	1913

Note: CV= Coefficient of Variance, SEm= Standard error of means, LSD= Least Significant Difference. Treatments means followed by the common letter (s) are not significantly different from each other based on DMRT at 5% level of significance.

2.2 Root Length, shoot length, Root/Shoot length ratio, Damping Off.

For organic fertilizers shoot length and root to shoot length ratio were found to be significantly different(P<0.01). Root length was insignificant with organic fertilizers and variety. Shoot length was significantly greater in trichocompost (7.980cm) than vermicompost(7.263cm) and control(5.167cm) but at par with peatmoss (7.853cm). Root and shoot length ratio was found significantly higher in control (2.977) than other organic fertilizers. However, the three organic fertilizers, peatmoss (2.118), vermicompost (2.007) and trichocompost (1.962) were at par to each other. For varieties shoot length and root to shoot length ratio were found to be significantly different(P<0.01). Variety Malini (7.413cm) had significantly longer shoot length than Dynasty(6.718cm). Root to shoot legth ratio was found significantly higher in variety dynasty (2.394) than malini (2.137).

Table 3: Influence of organic fertilizers and variety on root length, shoot length and root to shoot length ratio

Treatments	Root Length	Shoot length	Root/Shoot length ratio
Organic Fertilizers			
Peatmoss	16.89	7.980[a]	2.118[b]
Control	15.21	5.167[c]	2.977[a]
Vermicompost	14.58	7.263[b]	2.007[b]
Trichocompost	15.39	7.853[a]	1.962[b]
SEm(±)	0.390	0.1157	0.0577
LSD(=0.05)	NS	0.3510	0.1750
F test	NS	1%	1%
Varieties			
Malini	15.64	7.413[a]	2.137[b]
Dynasty	15.40	6.718[b]	2.394[a]
SEm(±)	0.276	0.0818	0.0408
LSD (=0.05)	NS	0.2482	0.1237
F test	NS	1%	1%
CV%	6.2	4	6.2
Grand Mean	15.52	7.066	2.266

Note: CV= Coefficient of Variance, SEm=Standard error of means, LSD= Least Significant Difference. Treatments means followed by the common letter (s) are not significantly different from each other based on DMRT at 5% level of significance.

For organic fertilizers; damping off 7DAS, 11DAS and 15 DAS were found to be significantly different(P<0.01). At 7DAS the highest effect against damping off was recorded in trichocompost(1.567%) and was followed by control(2.175%) being at par with vermicompost(2.686%) while poor performance was found in peatmoss(3.006%). Similarly, at 11DAS also trichocompost showed the best performance (3.750%) against damping off followed by control (7.083%) being at par with vermicompost (7.917%) and peatmoss with the highest damping off incidence (10.00%). At 15DAS trichocompost was superior with lowest damping off incidence (4.58%) followed by control (10.42%) and vermicompost (13.75%) while peatmoss with the least performance (16.67%). For varieties; damping off at 7DAS, 11DAS and 15 DAS were found to be significantly different(P<0.01). Irrespective of the days, variety dynasty showed the best performance over malini against damping off incidence.

Table 4: Influence of organic fertilizers and variety on disease incidence at 7DAS, 11DAS and 15DAS

Treatments	Disease Incidence		
	7 DAS	11 DAS	15 DAS
Organic Fertilizers			
Peatmoss	3.006[a]	10.00[a]	16.67[a]
Control	2.175[b]	7.083[b]	10.42[c]
Vermicompost	2.686[ab]	7.917[b]	13.75[b]
Trichocompost	1.567[c]	3.750[c]	4.58[d]
SEm(±)	0.2494	0.605	0.673
LSD(=0.05)	0.5348	1.835	2.041
F test	0.01	0.01	0.01
Varieties			
Malini	3.014	10.21[a]	14.79[a]

Dynasty	1.703	4.17[b]	7.92[b]
SEm(±)	0.1763	0.428	0.476
LSD (=0.05)	0.3782	1.297	1.443
F test	0.01	0.01	0.01
CV%	18.3	20.6	14.5
Grand Mean	2.359	7.19	11.35

Note: CV= Coefficient of Variance, SEm=Standard error of means, LSD= Least Significant Difference. Treatments means followed by the common letter (s) are not significantly different from each other based on DMRT at 5% level of significance.

4. Discussion

In recent years, interest in the use of organic fertilizers as a potting media has grown particularly with respect to their use as environment friendly efficient media for germination, increased vigour and healthy growth of seedlings. In this study, trichoderma inoculated trichocompost increased germination percentage and germination index, which finally produced healthier and vigorous seedlings. This could be due to interactions between Trichoderma, pathogen and plant that helped to maintain proper environment for the germination and growth of seedlings (Vinale et al., 2008). Higher germination and germination index also could be due to the production of Indole Acetic Acid produced by the strain of Trichoderma harzianum.

Trichocompost also had significant effect on root length($P<0.05$), number of leaves($P<0.01$) and leaf width($P<0.01$) which was supported (Yedidia et al., 1999). Their experiment demonstrated that Trichoderma harzianum increased the chitinase and peroxidase activities in roots as well as leaves of treated plants where treated roots showed 6.4 fold increase and treated leaves showed 3.2 fold increased compared with the non treated plants at peak chitinase activity while treated plants showed 2-3 fold increase in both activities in root and leaves at peak peroxidase activity. Trichocompost significantly increased the root length ($P<0.05$) and shoot length($P<0.01$) of seedlings. The result was similar to the experiment shown (Harman et al., 2004). Their experiment on 30 treated and 30 untreated maize inbred line Mo17 resulted significant increase in root length and shoot length on Trichoderma harzianum strain T22 treated plants. Seedlings grown in trichocompost had increased dry weight. Similar results were shown in experiment done on tomato, pepper and cucumber on radish (Chang et al., 1986; Baker et al., 1984). Also, trichocompost itself contained nutrients and organic matter available for seedling growth.

Seedlings grown in trichocompost had the lowest disease incidence ($P<0.01$). This could be due to the antagonistic nature of Trichoderma on other pathogenic fungi (Vinale et al., 2008). It also colonizes the root and stimulates the plant defense system, leading to the production of biochemical and structural compounds (Yedidia et al., 1999; Harman et al., 2004; Harman, 2006; Ousley et al., 1994). Some researcehrs suggested that peptaibols trichorzianin synthesized by Trichoderma inhibited β- 1,3 glucan synthatase activity in host fungus and preventing the reconstruction of pathogen cell wall, thus fascilitating the disruptive action of T. harzianum β- 1,3 glucanases (Lorito et al., 1996). This could have caused the suppression of disease pathogens and helped to emerge seedling stronger and more vigorous. Trichoderma harzianum thus consistently promoted the overall growth of plant (Ousley et al., 1994).

Root length shoot length and vigor index was seen superior in peat moss. This could be due to less or non-compaction in this potting media which could have provided more aeration and helped in easy elongation of roots and development of root hairs. The organic matter in peatmoss also stimulated the root and shoot growth of seedlings to make it more vigorous. The greater water holding capacity of peat moss helps to provide moisture persistently and thus water is available to the seed continuously. This could have increased the germination% and germination index in peatmoss media. Root to shoot length ratio was seen significantly higher in controlled condition. Since the controlled condition had lower water holding capacity, the available moisture and soluble nutrients in the media was comparatively lesser which caused slower growth of seedlings and thus shoot length was minimum. But the stress in root region caused plant to spread deeper for moisture and soluble nutrients and thus root length was higher. Similarly, variety malini was found to be superior at all parameters except damping off which is supported (Rawat, 2013). High damping off incidence in malini could be due to its vigorous growth which made it more succeptible to the disease.

5. Conclusion

The experiment was conducted to find out the effect of various sources of organic fertilizers on seedling health and vigor of different varieties of cucumber. Trichocompost had significantly higher germination, germination index, number of leaves, leaf width, fresh weight, dry weight, shoot length, and lowest damping off incidence. From this experiment it can be concluded that variety Malini in trichocompost proved to be better for raising seedlings of cucumber. Thus, it is suggested to use trichocompost as a potting media for raising nursery seedlings as it produced vigorous seedlings and suppressed the disease incidence. Though peatmoss also had positive results on seedling growth and vigour but it has several downsides. It is more expensive than trichocompost, non-renewable, and only commercially available while trichocompost is cost effective, easily prepared from locally available resource and can produce healthy seedlings.

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