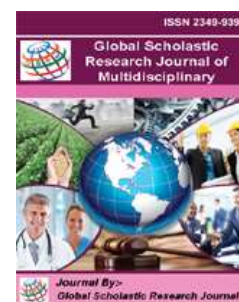




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ROOTING OF ORTHOTROPS AND RUNNERS IN BLACK PEPPER (*PIPER NIGRUM* L.)

RAMNARACE SUKHNA¹; OUDHO HOMENAUTH²

¹Research Scientist, National Agricultural Research & Extension Institute, Mon Repos, East Coast Demerara, Guyana

²Chief Executive Officer, National Agricultural Research & Extension Institute, Mon Repos, East Coast Demerara, Guyana

Abstract

The investigations on rooting of orthotrops and runners in black pepper (*Piper nigrum* L.)” were conducted at the pepper research unit attached to the Department of Plantation Crops and Spices, College of Horticulture, Kerala Agricultural University Main Campus, Vellanikkara during 2012-2014. The experiment was carried out with an objective to elucidate the effects of treatments, T₁ - IBA 1000 ppm, T₂ - cow dung slurry, T₃ - tender coconut water, T₄ - two per cent sugar and T₅ - charcoal paste in enhancing sprouting and root characters in two to three node semi hard wood orthotropic and runner shoots. The effect of different treatments on sprouting was varying in different months. The minimum time recorded from planting to initiation of sprouting in orthotrops and runners was 17 days. There was no significant difference among the treatments with respect to the length of primary roots, number of secondary roots/ plant, weight of roots (g), volume of roots (ml) and number of leaves/ plant in runners and orthotrops.

Key Words: Rooting, orthotrops, runners, *Piper nigrum*

1.1 INTRODUCTION

King of spices, black pepper (*Piper nigrum* L.) is the most potent member of the family *Piperaceae* (Abbasi *et al.*, 2010). Black pepper is native to India and is mostly cultivated in tropical and sub-tropical regions (Ahmad *et al.*, 2010). *P. nigrum* is widely used in cooking and processing of food and perfumery. The quality of peppercorn can be judged from its pungency contributed by active component, piperine (Philip *et al.*, 1992, Bhat *et al.*, 1995). Piperine is free from microbial contamination and biodeterioration, and preferred in processing of food items (Srinivasan, 2007). Black pepper had originated in the Western Ghats of India, which is a rich source of biodiversity. The extent of variability existing in black pepper in India is also very large which has been domesticated leading to a large number of genotypes with widely varying productivity levels.

The proposed study aimed to highlight the effect of certain treatments such as IBA, cow dung slurry, tender coconut water, sugar and charcoal paste in enhancing root initiation, length and number of roots in two to three node semi hard wood orthotropic and runner shoot.

2.1 MATERIALS AND METHODS

Two to three node semi hard wood orthotropic and runner shoots of mature healthy plants of Panniyur 1 were given the following treatments:

- T₁ - IBA 1000 ppm
- T₂ - Cow dung slurry
- T₃ - Tender coconut water
- T₄ - Two per cent sugar
- T₅ - Charcoal paste
- T₆ - Control

Cut ends of two to three node semi hard wood orthotropic and runner shoots were kept for 45 seconds in IBA 1000 ppm, five minutes in cow dung slurry, one minute in two per cent sugar and 12 h in 25 per cent tender coconut water before planting in polybags containing potting mixture. In the case of charcoal paste, cut ends of orthotropic and runner shoots were dipped in paste before planting.

Thirty cuttings were planted per treatment at monthly intervals during February, March, April, May and June of 2013.

Completely randomized design (CRD) was adopted for laying out the experiment. There were a total of six treatments which was replicated three times with 10 plants per replication. The following observations were taken:

- Number of cuttings sprouted
- Time taken from planting to initiation of sprouting
- Number and length of primary roots
- Number of secondary and tertiary roots three months after planting

➤ Weight and volume of roots three months after planting

Data generated on the various parameters of the experiment was analyzed statistically. ANACOVA was performed on data collected using the statistical package, 'MSTAT'. CD was calculated.

3.1 RESULTS AND DISCUSSION

3.11 Effect of different treatments on sprouting of orthotrops in black pepper var. Panniyur 1

In Tables 1 - 5 the effect of different treatments on sprouting of orthotrops in black pepper var. Panniyur 1 are presented.

Table 1. Effect of different treatments on sprouting of orthotrops in black pepper var. Panniyur 1 planted in February 2013

Treatment	Number of cuttings sprouted 21 days after planting	Number of cuttings sprouted 28 days after planting	Number of cuttings sprouted 35 days after planting	Days taken from planting to initiation of sprouting
T ₁	3.66 ^{abc} (2.03)	7.33 ^a (2.79)	9.66 ^a (3.18)	17
T ₂	2.66 ^c (1.77)	8.66 ^a (3.02)	10.00 ^a (3.24)	18
T ₃	5.00 ^a (2.33)	7.66 ^a (2.85)	9.00 ^{ab} (3.07)	17
T ₄	4.33 ^{ab} (2.18)	8.66 ^a (3.02)	9.66 ^a (3.18)	18
T ₅	3.00 ^{bc} (1.85)	7.66 ^a (2.85)	9.00 ^{ab} (3.07)	19
T ₆	1.00 ^d (1.22)	5.33 ^b (2.40)	7.66 ^b (2.85)	19

Table 2. Effect of different treatments on sprouting of orthotrops in black pepper var. Panniyur 1 planted in March 2013

Treatment	Number of cuttings sprouted 21 days after planting	Number of cuttings sprouted 28 days after planting		Days taken from planting to initiation of sprouting
T ₁	6.00 ^{ab} (2.46)	7.00 ^{ab} (2.70)	7.66 ^{bc} (2.84)	18
T ₂	8.66 ^a (3.02)	9.00 ^a (3.08)	10.00 ^a (3.24)	18
T ₃	8.66 ^a (3.02)	9.00 ^a (3.08)	9.33 ^{ab} (3.13)	17
T ₄	7.66 ^{ab} (2.85)	8.33 ^a (2.96)	8.66 ^{ab} (3.02)	18
T ₅	6.33 ^{ab} (2.61)	6.66 ^{ab} (2.67)	7.00 ^c (2.73)	19
T ₆	4.66 ^b (2.27)	5.33 ^b (2.40)	7.66 ^{bc} (2.85)	19

Table 3. Effect of different treatments on sprouting of orthotrops in black pepper var. Panniyur 1 planted in April 2013

Treatment	Number of cuttings sprouted 21 days after planting	Number of cuttings sprouted 28 days after planting	Number of cuttings sprouted 35 days after planting	Days taken from planting to initiation of sprouting
T ₁	4.00 ^d (2.11)	6.66 ^b (2.65)	8.33 ^{ab} (2.96)	17
T ₂	6.33 ^{bc} (2.60)	8.00 ^{ab} (2.91)	9.33 ^{ab} (3.13)	18
T ₃	9.00 ^a (3.08)	9.66 ^a (3.18)	9.66 ^a (3.18)	17
T ₄	4.66 ^{cd} (2.26)	6.33 ^b (2.59)	7.33 ^b (2.78)	18
T ₅	7.00 ^{ab} (2.72)	8.66 ^{ab} (3.02)	9.33 ^{ab} (3.13)	19
T ₆	7.66 ^{ab} (2.84)	8.66 ^{ab} (3.02)	9.66 ^a (3.18)	19

Table 4. Effect of different treatments on sprouting of orthotrops in black pepper var. Panniyur 1 planted in May 2013

Treatment	Number of cuttings sprouted 21 days after planting	Number of cuttings sprouted 28 days after planting	Number of cuttings sprouted 35 days after planting	Days taken from planting to initiation of sprouting
T ₁	8.00 ^{ab} (2.91)	8.66 ^{ab} (3.02)	9.00 ^{ab} (3.07)	17
T ₂	6.66 ^b (2.67)	7.66 ^b (2.85)	8.00 ^b (2.91)	18
T ₃	7.33 ^{ab} (2.79)	7.66 ^b (2.85)	7.66 ^b (2.85)	17
T ₄	8.33 ^{ab} (2.96)	8.66 ^{ab} (3.02)	8.66 ^{ab} (3.02)	18
T ₅	8.66 ^a (3.02)	9.33 ^a (3.13)	10.00 ^a (3.24)	18
T ₆	8.66 ^a (3.02)	9.33 ^a (3.13)	9.33 ^{ab} (3.13)	19

Table 5. Effect of different treatments on sprouting of orthotrops in black pepper var. Panniyur 1 planted in June 2013

Treatment	Number of cuttings sprouted 21 days after planting	Number of cuttings sprouted 28 days after planting	Number of cuttings sprouted 35 days after planting	Days taken from planting to initiation of sprouting
T ₁	4.66 ^b (2.24)	6.00 ^b (2.53)	7.00 ^a (2.72)	17
T ₂	7.00 ^{ab} (2.73)	7.00 ^{ab} (2.73)	7.00 ^a (2.73)	17
T ₃	4.33 ^b (2.19)	7.00 ^{ab} (2.72)	7.66 ^a (2.85)	17
T ₄	8.66 ^a (3.01)	9.33 ^a (3.13)	9.33 ^a (3.13)	17
T ₅	7.66 ^a (2.84)	8.66 ^{ab} (3.02)	8.66 ^a (3.02)	18
T ₆	6.33 ^{ab} (2.60)	7.66 ^{ab} (2.84)	9.33 ^a (3.13)	19

In the month of **February**, T₃ - tender coconut water had significant effect on the number of cuttings sprouted 21 days after planting. 28 days after planting maximum sprouting was noticed in all treatments with the exception of control (Table 1). It could be observed that T₁ -

IBA 1000 ppm for 45 seconds, T₂ - cow dung slurry, T₃ - tender coconut water, T₄ - two per cent sugar and T₅ - charcoal paste exerted significant effect on sprouting of orthotropic cuttings.

In the month of **March** maximum sprouting was evident in treatments T₂ - cow dung slurry and T₃ - tender coconut water 21 days after planting. Also in March maximum sprouting was observed in almost all treatments 28 days after planting (Table 2).

In **April** maximum sprouting of orthotropic cuttings was noticed in T₃ - tender coconut water 21 days after planting. Maximum sprouting was achieved 35 days after planting in all the treatments including control (Table 3).

In **May**, T₅ - charcoal paste had maximum effect on sprouting of orthotropic shoots 21 days after planting. T₆ - control also showed maximum sprouting of cuttings 21 days after planting. Favorable sprouting was also noticed in T₁ - IBA 1000 ppm for 45 seconds, T₃ - tender coconut water and T₄ - two per cent sugar 21 days after planting. Maximum sprouting in all treatments was achieved 35 days after planting (Table 4).

In **June** maximum sprouting was noticed in cuttings treated with T₄ - two per cent sugar and T₅ - charcoal paste 21 days after planting. Maximum sprouting was observed in almost all treatments 28 days after planting (Table 5).

Throughout the experimental period initiation of sprouting was observed in 17 to 19 days in all treatments. The total number of cuttings sprouted in different treatments ranged from 7 to 10. The effect of different treatments in sprouting was varying in different months. T₂ - cow dung slurry was the best treatment during February and March planting whereas T₃ - tender coconut water and control were superior in April.

In May planting, 100 per cent sprouting was observed in cuttings treated with T₅ - charcoal paste. In June T₄ - two per cent sugar and control were superior. Thus it can be seen that treatment effects are varying in different months.

3.12 Effect of different treatments on root characters of orthotrops in black pepper var. Panniyur 1

In tables 6 - 10 the effect of different treatments on root characters of orthotrops such as length of primary roots/ plant, number of secondary roots/ plant, weight of roots (g), volume of roots (ml) and number of leaves/ plant are presented.

Table 6. Effect of different treatments on root characters of orthotrops in black pepper var. Panniyur 1 planted in February 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	12.03	14.35	0.77	1.60	3.14
2	14.75	20.51	0.54	1.15	2.99
3	14.14	15.98	0.87	1.75	2.24
4	16.01	22.45	1.03	1.84	2.96
5	13.65	16.19	0.73	1.41	2.71
6	17.18	18.91	0.79	1.54	3.54
CD (5 %)	NS	NS	NS	NS	NS

Table 7. Effect of different treatments on root characters of orthotrops in black pepper var. Panniyur 1 planted in March 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	6.94	11.72	0.44	0.88	3.36
2	8.15	11.34	0.59	1.47	3.34
3	7.10	14.16	0.43	0.79	3.21
4	6.40	15.49	0.63	1.10	2.82
5	5.61	11.98	0.47	0.91	2.78
6	6.47	8.28	0.35	0.48	0.87
CD (5 %)	NS	NS	NS	NS	1.45

Table 8. Effect of different treatments on root characters of orthotrops in black pepper var. Panniyur 1 planted in April 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	20.34	24.83	0.80	1.55	4.99
2	13.23	19.14	0.62	1.55	5.20
3	13.9	19.54	0.52	1.14	5.79
4	13.71	20.87	0.72	1.43	6.60
5	18.27	24.18	0.71	1.42	6.59
6	13.75	23.21	0.34	0.70	6.40
CD (5 %)	NS	NS	NS	NS	NS

Table 9. Effect of different treatments on root characters of orthotrops in black pepper var. Panniyur 1 planted in May 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	9.51	16.76	0.68	1.28	7.19
2	16.90	21.49	0.61	1.20	6.96
3	14.07	17.66	0.45	0.96	6.61
4	13.43	16.59	0.58	1.16	6.21
5	21.78	26.32	0.50	1.00	5.68
6	13.93	18.16	0.20	0.22	5.33
CD (5 %)	NS	NS	NS	NS	2.19

Table 10. Effect of different treatments on root characters of orthotrops in black pepper var. Panniyur 1 planted in June 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	6.24	14.06	0.76	1.42	6.97
2	4.01	4.28	0.57	1.12	5.79
3	1.70	2.77	0.44	0.91	6.79
4	2.11	5.31	0.58	1.11	6.40
5	4.49	5.38	0.51	1.09	6.65
6	5.17	7.53	0.18	0.18	5.39
CD (5 %)	NS	5.86	NS	NS	NS

T₁ - IBA 1000 ppm for 45 seconds

T₂ - Cow dung slurry

T₃ - Tender coconut water

T₄ - Two per cent sugar

T₅ - Charcoal paste

T₆ - Control

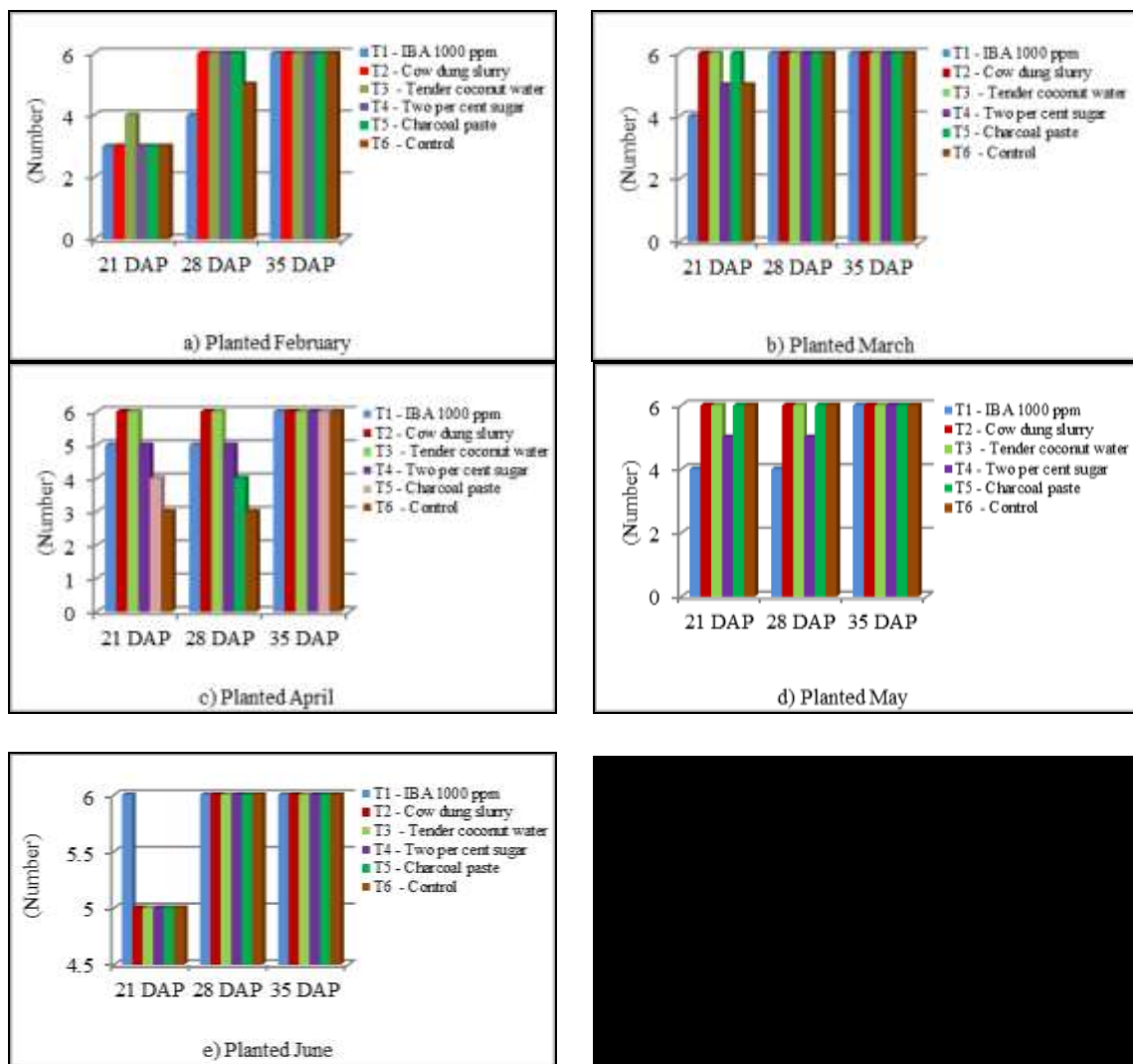
As can be seen in tables 6 - 10 the different treatments for the rooting of cuttings did not have any significant effect from February to June on length of primary roots, number of secondary roots (except in March) and weight and volume of roots. The only significant influence with respect to root characters was the superiority of IBA 1000 ppm in March 2013 in the number of secondary roots. This was not repeated in the other months. The number of primary roots was maximum in cuttings treated with IBA 1000 ppm (T₁) during February, April, May and June planting. During March, cuttings treated with charcoal paste (T₅) recorded maximum number of primary roots. Sujatha and Nybe (2008) also reported that IBA treatment did not have significant effect on rooting of pepper cuttings of five varieties.

In the month of June, cuttings treated with charcoal paste produced the highest number of primary roots/ plant (Table 26). According to (Pillai *et al.*, 1982, Shridhar and Singh, 1990) dipping of nodal cuttings in 1000 ppm IBA for 45 seconds gave better rooting in polybag. Sarma *et al.* (2013) reported that rooting percentage of orthotrops varied from 70 to 80 per cent. Sujatha (1997) obtained 90 per cent rooting in two node cuttings dipped in 1000 ppm IBA and kept in a polytent with regular watering. Sasikumar and George (1992) found that

single node cuttings planted in polybags and kept in pits covered with polysheet with frequent water sprays gave above 90 per cent rooting without hormone treatment.

3.13 Rooting of runner shoots

In Fig.1. the effect of different treatments on sprouting of runners in black pepper var. Panniyur 1 is presented. In Fig.2. the number of days taken from planting to initiation of sprouting of runners in black pepper var. Panniyur 1 is presented.



*DAP: Days after planting

Fig.1. Effect of different treatments on sprouting of runners in black pepper var. Panniyur 1

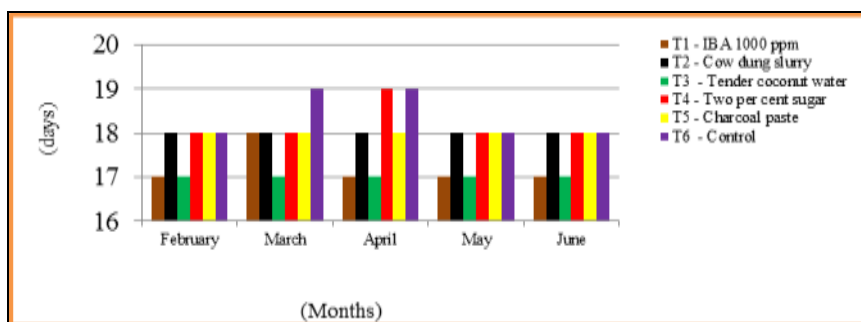


Fig.2. Days taken from planting to initiation of sprouting of runners in black pepper var. Panniyur 1

After the monthly data was thoroughly scrutinized, it indicated that 90 per cent of runner shoots sprouted 21 days after planting in the months of March, April, May and June in all the treatments. February was the only month in which 50 per cent sprouting was observed 21 days after planting (Fig.1.). As in the case of time taken from planting to initiation of sprouting of runners, the minimum time of 17 days was recorded from February to June whereas the maximum time reaching up to 19 days (Fig.2.). Throughout the experiment period all the cuttings sprouted irrespective of treatments including control probably indicating that sprouting is independent of treatments imposed.

3.14 Effect of different treatments on root characters of runners in black pepper var. Panniyur 1

In tables 16 - 20 the effect of different treatments on root characters of runners such as length of primary roots/ plant, number of secondary roots/ plant, weight of roots (g), volume of roots (ml) and number of leaves/ plant are presented.

Table 16. Effect of different treatments on rooting of runners in black pepper var. Panniyur 1 planted in February 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	1.73	4.79	0.08	0.16	1.07
2	1.83	5.30	0.12	0.14	1.55
3	2.06	0.04	0.51	1.11	3.69
4	2.51	7.08	0.09	0.18	1.83
5	3.61	7.75	0.14	0.24	1.29
6	3.99	10.03	0.21	0.42	1.73
CD (5 %)	NS	NS	NS	NS	NS

Table 17. Effect of different treatments on rooting of runners in black pepper var. Panniyur 1 planted in March 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	1.62	3.06	0.21	0.27	1.23
2	1.82	2.01	0.18	0.28	1.24
3	1.52	1.08	0.26	0.47	1.36
4	2.17	3.38	0.44	0.85	1.75
5	3.17	7.38	0.55	0.91	1.75
6	1.22	0.71	0.33	0.62	1.04
CD (5 %)	NS	NS	NS	NS	NS

Table 18. Effect of different treatments on rooting of runners in black pepper var. Panniyur 1 planted in April 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	4.60	5.80	0.19	0.31	2.22
2	4.65	2.47	0.14	0.24	1.69
3	8.62	8.50	0.21	0.36	3.11
4	5.30	5.90	0.31	0.66	2.20
5	2.23	3.59	0.43	0.81	1.13
6	5.88	4.25	0.32	0.65	1.42
CD (5 %)	NS	NS	NS	NS	1.16

Table 19. Effect of different treatments on rooting of runners in black pepper var. Panniyur 1 planted in May 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	9.56	14.69	0.79	1.49	3.06
2	11.81	18.26	0.74	1.54	2.80
3	9.90	10.01	0.62	1.10	3.93
4	9.98	16.84	0.78	1.48	2.96
5	10.30	14.25	0.78	1.49	3.48
6	13.57	14.41	0.72	1.49	3.74
CD (5 %)	NS	NS	NS	NS	NS

Table 20. Effect of different treatments on rooting of runners in black pepper var. Panniyur 1 planted in June 2013

Treatment	Length of primary roots/ plant (cm)	Number of secondary roots/ plant	Weight of roots/ plant (g)	Volume of roots/ plant (ml)	Number of leaves/ plant
1	11.90	11.91	0.17	0.19	2.43
2	12.64	12.65	0.19	0.24	3.29
3	15.63	15.64	0.23	0.42	3.16
4	11.90	11.22	0.18	0.29	2.64
5	9.08	9.08	0.19	0.41	2.70
6	8.15	8.15	0.22	0.31	3.16
CD (5 %)	NS	4.36	NS	NS	NS

T₁ - IBA 1000 ppm for 45 seconds

T₂ - Cow dung slurry

T₃ - Tender coconut water

T₄ - Two per cent sugar

T₅ - Charcoal paste

T₆ - Control

Like in orthotrops, observations carried out in February, March and May showed that, **T**₁ - IBA 1000 ppm for 45 seconds, **T**₂ - cow dung slurry, **T**₃ - tender coconut water, **T**₄ - two per cent sugar and **T**₅ - charcoal paste did not show significant effect on length of primary roots,

number of secondary roots/ plant, weight of roots (g), volume of roots (ml) and number of leaves/ plant (Tables 16, 17 & 19). Exception were seen in the months of April and June where T₃ - tender coconut water had significant effect on the number of secondary roots/ plant and number of leaves/ plant respectively (Tables 18 & 20).

Yufdi and Ernawati (1982) reported that cuttings treated with 25 per cent coconut water for 12 h increased root and shoot length, number of roots and shoot dry weight. Analyzed data indicated that in the months of February and March cuttings treated with T₃ - tender coconut water recorded the highest number of primary roots/ plant (Table 27). In February planting, control plants were statistically on par with T₁ - IBA 1000 ppm in the number of primary roots produced. In April T₄ - two per cent sugar recorded the highest number of primary roots/ plant. In June the highest number of primary roots/ plant was recorded in cuttings treated with T₅ -charcoal paste (Table 27).

4.1 CONCLUSION

- The minimum time recorded from planting to initiation of sprouting in orthotrops and runners was 17 days.
- The different treatments failed to have significant effect on length of primary roots, number of secondary roots/ plant, weight of roots (g), volume of roots (ml) and number of leaves/ plant in orthotrops as well as runners.
- In orthotrops the maximum number of primary roots was recorded in cuttings treated with IBA 1000 ppm (T₁).

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