IMPROVING MANAGEMENT PRACTICES FOR TRANSPLANT PRODUCTION OF CHILI PEPPER (*Capsicum annuum* L.)

Anas D. Susila[1)], Tisna Prasetyo[1)], Manuel C. Palada [2)]

[1)] Plant Production Division, Departemen of Agronomy and Horticulture, Faculty of Agcriculture, Bogor Agricultural University Jl. Meranti, Komplek IPB Darmaga Bogor. 16680, Tel/Fax: 0251 629353. Email: anasdsusila@yahoo.com

[2)] Crop and Ecosystems Management Unit, AVRDC-World Vegetable Center, P.O. Box 42, Shanhua, Tainan 74199, Taiwan

ABSTRACT

This study evaluated the transplant production technique which produces chili pepper (Capsicum annuum L.) and ensures healthy, strong and uniform transplants, using the 'Prabu' variety to find out the effect of transplant media, cell size of transplant tray, fertilizing, and the method of seed preparation on the growth of chili pepper transplants. It used the Randomized Completely Block Design consisting of 32 treatments with three replications. The treatment was combined between transplant media (vermicompost, compost, topsoil + compost, and topsoil +) with tray cell size (72 cells and 128 cells per tray), and fertilization (G-14-12-14 (14%N:12%P_2O_5:14%K_2O) and no fertilizer, and seed preparation methods (direct seeding in trays or germinated). The results showed that vermicompost was the appropriate media for chili pepper transplant production due to its production of higher fresh biomass, and led to increased plant height and higher number of leaves than produced by the other media. The longest root length was obtained by the application of compost. There was no difference between direct seeding or germinated seed treatment on the transplant performance. However fertilizer application during transplant production increased all measured variables. Larger cell size significantly increased fresh biomass and root length, but not plant height and number of leaves.

Keywords: *transplant production, transplant medium, fertilizer, cell size, germinate, chili pepper*

INTRODUCTION

In the practice of chili cultivation, seedbeds are used to prepare healthy, strong and uniform chili transplants as planting materials that are moved to the field. Chili seeds, when they are sown in the greenhouse nursery, are known to have better germination, are more easily maintained and have lower risk of dying compared with the seeds that are planted directly in the field. In addition, the more controlled environment in the nursery building can support seed germination and better plant growth.

Roots have an important role in the growth and development of transplants. They need enough space in which to grow so as to absorb water, nutrients, and air. If the plant roots have stress, the plants will be unable to absorb water, nutrients and air and thus will not enable the seeds to develop optimally (Vavrina, 2001). A very influential factor in the growth and development of plant roots is the quality of media, including nurseries and the place or rooms to grow these plants.

A good medium for transplant production is that which is able to provide sufficient water and nutrients, has enough space for gas exchange to and from the roots, and able to sustain plant growth. The kascing *(vermicompost)* is one of the growth media that have begun to be widely used for nurseried media. It provides enough nutrients such as 0.63% nitrogen (N), 0.35% phosphorus (P_2O_5), 0.20% potassium (K_2O), 0.23% calcium (Ca), 0.26% magnesium (Mg), and micro nutrient (17:58 ppm Cu, 0007 ppm Zn, 0003 ppm Mn, 0.7 Fe, ppm Bo 0:21, and 14:48 ppm Mo) at a water holding capacity of 41.23% and cation exchange capacity (CEC) of 35.80 meq/100g (Susila *et al*, 2007).

Seed can be sown directly in the fertile soil, in pots, or in polybags and seedling trays. A seedling tray is a container that consists of several holes (cells), usually holding 55, 72, or even 128 cells for each tray. The more cells in the tray, the smaller the cell volume. The use of seedling trays has the advantage of providing one cell (hole) for a single plant so that seeds will not compete with other seeds, and the plants will be more easily separated than with the use of pots or seedbeds or polybags directly on the ground.

The addition of nutrients to the nursery media can also improve the growth and development of plant seeds. Vavrina (1993) stated that the seedling growth of tomato plants in nurseries can be improved by adding elements of N in seedlings (of tomato plants) in the range of 35-75 mg/l N. Not many farmers are aware or have knowledge of good cultivation techniques in transplant production. For instance, the right media to use, fertilizer application techniques, the use of tray seedlings, and seeding techniques for nurseries. Many farmers also do not implement techniques on intensive plant cultivation and maintenance in nurseries. With intensive plant cultivation techniques and plant maintenance, the output will be good quality seeds which in turn will be able to produce plants that will give the maximum yield. This study examined the influence of the media, fertilizer treatment, seedling tray size and method of seeding the seeds on chili transplant quality.

MATERIALS AND METHODS

Research was conducted in March-April 2007 in *SANREM-base camp,* the Hambaro village, Nanggung sub-district, Bogor, Indonesia, using as plant material a large red Chili var. Four transplant media were tested:

1) kascing *(vermicompost),*
2) compost,
3) a mixture of *topsoil* with compost (1:1) and
4) a mixture of *topsoil* with a pasteurized compost.

Fertilization treatment was done by using a foliar fertilizer (14-12-14: 14% N-12% P_2O_5-14% K_2O) of 250 ml per *tray* with a concentration of 2 g/l which was applied everyday starting at 7 days after seed germination. This method was done by sowing seeds before pricking the transplant (indirectly) or they were directly sown in a seedling *tray.*

Planting seeds of chili indirectly was performed with germinated seeds placed on *tissue* paper soaked in water and stored in a dark room for 7 days and then pricked in the *tray.* Sprouted seeds and chili pepper seedlings were planted in a *tray (each tray* measured 72 and 128 cells). Chili seed trays were stored in the nursery for 5 weeks, and everyday flushed with water (at a volume of 1 liter of water per *tray).* Observations and measurement were conducted 5 weeks after germination.

The experiment used the full Randomized Completely Block Design (RCBD) which consisted of 32 treatments with three replications for each treatment, so there were 96 experimental units. The treatment tested was a combination of 4 factors: media nurseries (4 levels), seedling tray size (2 levels), fertilization (2 levels) and method of planting seeds (2 levels). The combination treatment in this study can be seen in Table 1.

Observations were made during the last week in the nursery (5 weeks after germination) on several variables: plant height, root length, number of leaves, plant weight (fresh), uniformity, and incidence of pest and disease. The data obtained was analyzed using the F test *(SAS System),* and if it showed a significant effect, this was followed by a further test DMRT *(Duncan Multiple Range Test)* at 5% level. To see the effects of combination treatment combination the *Orthogonal Contrast* test was used.

Table 1. Treatment Combination for Chili Transplant Production

Treatment	*Media*	*Cell Size*	*Fertilizer*	*Seed Preparation*
M1.C1.F0.G0	*Vermicompost*	72	*No Fertilizer*	*Direct*
M1.C2.F0.G0	*Vermicompost*	128	*No Fertilizer*	*Direct*
M2.C1.F0.G0	*Compost*	72	*No Fertilizer*	*Direct*
M2.C2.F0.G0	*Compost*	128	*No Fertilizer*	*Direct*
M3.C1.F0.G0	*Top Soil + Compost*	72	*No Fertilizer*	*Direct*
M3.C2.F0.G0	*Top Soil + Compost*	128	*No Fertilizer*	*Direct*
M4.C1.F0.G0	*Top Soil + Compost Pasteurized*	72	*No Fertilizer*	*Direct*
M4.C2.F0.G0	*Top Soil + Compost Pasteurized*	128	*No Fertilizer*	*Direct*
M1.C1.F1.G0	*Vermicompost*	72	*G 14-12-14*	*Direct*
M1.C2.F1.G0	*Vermicompost*	128	*G 14-12-14*	*Direct*
M2.C1.F1.G0	*Compost*	72	*G 14-12-14*	*Direct*
M2.C2.F1.G0	*Compost*	128	*G 14-12-14*	*Direct*
M3.C1.F1.G0	*Top Soil + Compost*	72	*G 14-12-14*	*Direct*
M3.C2.F1.G0	*Top Soil + Compost*	128	*G 14-12-14*	*Direct*
M4.C1.F1.G0	*Top Soil + Compost Pasteurized*	72	*G 14-12-24*	*Direct*
M4.C2.F1.G0	*Top Soil + Compost Pasteurized*	128	*G 14-12-24*	*Direct*
M1.C1.F0.G1	*Vermicompost*	72	*No Fertilizer*	*Germinated*
M1.C2.F0.G1	*Vermicompost*	128	*No Fertilizer*	*Germinated*
M2.C1.F0.G1	*Compost*	72	*No Fertilizer*	*Germinated*
M2.C2.F0.G1	*Compost*	128	*No Fertilizer*	*Germinated*
M3.C1.F0.G1	*Top Soil + Compost*	72	*No Fertilizer*	*Germinated*
M3.C2.F0.G1	*Top Soil + Compost*	128	*No Fertilizer*	*Germinated*
M4.C1.F0.G1	*Top Soil + Compost Pasteurized*	72	*No Fertilizer*	*Germinated*
M4.C2.F0.G1	*Top Soil + Compost Pasteurized*	128	*No Fertilizer*	*Germinated*
M1.C1.F1.G1	*Vermicompost*	72	*G 14-12-14*	*Germinated*
M1.C2.F1.G1	*Vermicompost*	128	*G 14-12-14*	*Germinated*
M2.C1.F1.G1	*Compost*	72	*G 14-12-14*	*Germinated*
M2.C2.F1.G1	*Compost*	128	*G 14-12-14*	*Germinated*
M3.C1.F1.G1	*Top Soil + Compost*	72	*G 14-12-14*	*Germinated*
M3.C2.F1.G1	*Top Soil + Compost*	128	*G 14-12-14*	*Germinated*
M4.C1.F1.G1	*Top Soil + Compost Pasteurized*	72	*G 14-12-14*	*Germinated*
M4.C2.F1.G1	*Top Soil + Compost Pasteurized*	128	*G 14-12-14*	*Germinated*

Description: M1: Kascing *(Vermicompost)*; M2: Compost; M3: *Topsoil + Compost* (ratio 1: 1), M4: *Topsoil + Compost Pasteurized* (ratio 1:1), pasteurization is done by heating the media with steam for 2 hours. C1: 72 *Cell size*, C2: 128 *Cell size*, F0: Non-Fertilized, F1: Fertilized (G Leaf Fertilizer 14-12-14: 14% N - 12% P_2O_5 - 14% K_2O was applied by flushing the media as much as 250 ml per *tray* with fertilizer concentration 2 g / l, applied every day began at 7 days after germination). G0: *Direct* (direct seeding: 1 seed / cell), G1: *Germinated* - seeds germinate in toilet paper soaked in water and stored in a dark room for 7 days after it was pricked out to a *tray* for seedlings)

RESULTS AND DISCUSSION

Transplant production was implemented in nursery building with air humidity at 80-90% and intensity of shade at 65%. At the time of the study pests and diseases that had attacked them were *phytium* sp. (0.26%), thrips (0.10%) and TMV or Tomato Mozaic Virus (0.16%). The level of

seed uniformity was observed visually, by looking at a high uniformity of the plants. Seeds planted in a 72-cell tray showed a 90% level of uniformity, while the seeds planted in a 128-cell tray showed a uniformity level of 75%. Percentage of germination of the seed sown in tissue paper was 100%.

The influence of the germination methods, fertilization, and cell size on the quality of chili transplants are presented in Table 2. The results showed that the seeding method did not have a significant difference between the seed sown directly in the seeding tray or that which was germinated in a tissue paper first. Fertilization treatment using foliar fertilizer showed that the chilli

Table 2. Influence of methods of germination, fertilization and cell size on growth Seed *Tray* Chili

Variable Contrast	Fresh Biomass (g)	Root Length (cm)	Plant Height (cm)	Number of Leaves
Germinate	15.64	3.50	12.72	5.83
Direct	16.99	3.46	13.52	6:04
Response	ns	ns	ns	ns
Fertilize	23.43	3.94	17.38	7.65
Non-Fertilize	9.20	3.02	8.86	4.22
Response	**	**	**	**
Cell size 72	17.51	3.77	13.24	6.12
Cell size 128	15.12	3.19	13.00	5.74
Response	*	*	ns	ns

ns=non significant, * = significant different at 5% level, **= significant at 1% level.

Table 3. Influence of growth media on Chili transplant

Variable	Fresh Biomass (g)	Root Length (cm)	Plant Height (cm)	Number of Leaves
Treatment				
Vermicompost (M1)	20.18	3.80	18.35	7.51
Compost (M2)	15.21	4:47	10.24	5.28
Topsoil + compost (M3)	15.47	2.96	11.77	5.40
Topsoil + pasteurized compost (M4)	14.40	2.68	12.12	5.54
M1 + M2	17.69	4.14	14.29	6.4
M3 + M4	14.94	2.82	11.95	5.47
Contrast Response				
M1 vs M2	**	*	**	**
M1 vs. M3	**	*	**	**
M1 vs M4	**	**	**	**
M2 vs M3	ns	**	*	ns
M2 vs. M4	ns	**	*	ns
M3 vs M4	ns	ns	ns	ns
M1 vs. M3+M4	**	**	**	**
M2 vs. M3+M4	ns	**	*	ns
M1+M2 vs M3 + M4	**	**	**	**

ns=non significant, * = significant different at 5% level, **= significant at 1% level.

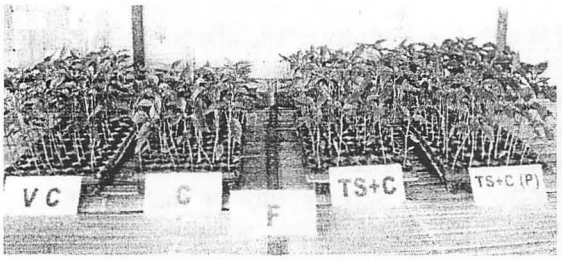

Figure 1. Chili transplants with fertilizer treatment (F). From left to right : with Vermicomposting (VC), compost (C), Top soil +Compost (TS+C), Top soil +Compost +pasteurized (TS+C+P)

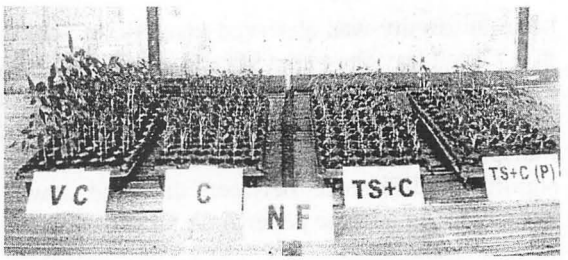

Figure 2. Chili transplants with no fertilizer treatment (NF). From left to right : with Vermicomposting (VC), compost (C), Top soil +Compost (TS+C), Top soil +Compost +pasteurized (TS+C+P)

Table 4. Effects of media, cell size, fertilization, and seedling method on transplant chili growth

Treatment	Fresh Biomass (g)		Root Length (cm)		Plant Height (cm)		Number of Leaves	
M1.C1.F0.G0	19.99	bcde	4.40	abcde	18.43	abc	7.4	ab
M1.C2.F0.G0	17.83	cde	3.30	cdefg	18.33	abc	6.7	bc
M2.C1.F0.G0	7.35	f	3.60	bcdefg	6.93	ef	4.0	d
M2.C2.F0.G0	6.43	f	3.43	bcdefg	5.73	ef	3.0	d
M3.C1.F0.G0	6.59	f	3.20	cdefg	5.00	f	3.0	d
M3.C2.F0.G0	5.13	f	2.03	fg	5.50	f	3.3	d
M4.C1.F0.G0	6.65	f	2.03	fg	6.10	ef	3.5	d
M4.C2.F0.G0	6.10	f	2.00	fg	5.37	f	3.2	d
M1.C1.F1.G0	26.71	ab	3.73	bcdefg	20.77	a	8.6	a
M1.C2.F1.G0	24.25	abcd	3.57	bcdefg	20.53	a	8.4	a
M2.C1.F1.G0	24.92	abc	5.60	ab	15.77	abc	7.3	abc
M2.C2.F1.G0	24.50	abcd	4.90	abc	15.10	bcd	7.3	abc
M3.C1.F1.G0	27.75	a	3.07	cdefg	18.30	abc	7.2	abc
M3.C2.F1.G0	21.62	abcd	3.30	cdefg	16.53	abc	7.7	ab
M4.C1.F1.G0	27.02	ab	4.60	abcd	20.17	ab	8.3	ab
M4.C2.F1.G0	18.99	cde	2.53	defg	17.77	abc	7.6	ab
M1.C1.F0.G1	17.45	de	4.43	abcde	16.47	abc	7.9	ab
M1.C2.F0.G1	14.38	e	4.07	abcdef	15.57	abc	5.8	c
M2.C1.F0.G1	6.76	f	3.53	bcdefg	6.17	ef	3.1	d
M2.C2.F0.G1	7.47	f	3.67	bcdefg	7.00	ef	3.4	d
M3.C1.F0.G1	5.61	f	2.63	defg	5.60	ef	3.0	d
M3.C2.F0.G1	6.49	f	2.07	fg	6.43	ef	3.2	d
M4.C1.F0.G1	6.93	f	2.23	efg	6.80	ef	3.9	d
M4.C2.F0.G1	6.07	f	1.73	g	6.27	ef	3.1	d
M1.C1.F1.G1	22.97	abcd	3.40	bcdefg	18.50	abc	7.7	ab
M1.C2.F1.G1	17.81	cde	3.47	bcdefg	18.10	abc	7.7	ab
M2.C1.F1.G1	24.29	abcd	4.93	abc	10.70	de	7.1	abc
M2.C2.F1.G1	19.98	bcde	6.10	a	14.50	cd	6.9	abc
M3.C1.F1.G1	28.14	a	4.63	abcd	19.47	abc	8.3	ab
M3.C2.F1.G1	22.52	abcd	2.77	cdefg	17.37	abc	7.5	ab
M4.C1.F1.G1	21.08	abcde	4.23	abcdef	16.73	abc	7.7	ab
M4.C2.F1.G1	22.38	abcd	2.07	fg	17.80	abc	7.1	abc

Notes : M1: Vermicompost, M2: Compost, M3: Topsoil + Compost, M4: Topsoil + Compost Pasteurized. C1: Cell size 72, C2: Cell size 128, F0: Non-Fertilized, F1: Fertilized, G0: Direct, G1: Germinated

peppers transplanted with foliar fertilizer (14-12-14) had a higher growth (1.2 - 2.5 times more) compared to seeds that were not given fertilizer. The seedling tray size affected only the root length and plant fresh weight but had no effect on the height and number of leaves.

In the transplant media treatment (Table 3), the chili seeds that were sown in the kascing (vermicompost) had better transplant growth than the media compost, topsoil + compost, or topsoil + pasteurized compost. When a comparison was made of the compost media and the compost mixed with topsoil, better results were shown by the compost media in root length than that shown by topsoil and compost media either pasteurized or not. The combination of media topsoil + compost mixture gave better results inn transplant height while the fresh weight and number of leaves of transplants did not show significantly different result. Media topsoil + pasteurized and unpasteurized compost did not show different results in all variables observed. The effects of the treatments are presented in Figures 1 and 2, while the influence of all treatment combinations are shown in Table 4.

ACKNOWLEDGMENTS

This study received funding support from the United States Agency for International Development (USAID) for Sustainable Agriculture and Natural Resources Management Collaborative Research Support Program (SANREM CRSP) in the Cooperative Agreement Award No.. EPP-A-00-04-00013-00 to the Office of International Research and Development (OIRED) at Virginia Polytechnic Institute and State University (Virginia Tech).

REFERENCES

Susila, A.D., C.H. Ma, and M.C. Palada. 2007. Improving management practices for chili pepper (*Capsicum annuum L.*) with starter solution applicaton. GTZ-Chili Project Report-AVRDC.

Vavrina, C.S. 1993 Budless tomato plants: Nitrogen in the house and yield in the field. Florida Vegetable Transplant Growers New 4(1): 2-4.

Vavrina, C.S. 2001. Bigger Is Actually Better:A Study of Transplant Container Cell Size. Florida cooperative Extension Services, Institute of Food and Agricultural Sciences, University of Florida. Fact Sheet HS-814