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Full Length Research Paper

Substitution of municipal solid waste compost for peat in cucumber transplant production

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Municipal solid waste compost (MSWC) is used in agriculture as a fertilizer, organic soil additive and crop substrate. MSWC was examined as an alternative for peat in cucumber (*Cucumis sativus* L., cv. Radian) transplant production. An experiment was conducted in 2008 at the University of Guilan, Rasht, Iran with the treatments 100% peat+0% MSWC (control); 95% peat+5% MSWC, 90% peat+10% MSWC, 85% peat+15% MSWC and 80% peat+20% MSWC. Seedlings grown in the only peat and peat+MSWC (5%) mixture had better quality and suitability for transplanting. There were differences due to substrate with a general reduction in values as MSWC rate increased. Use of MSWC is not recommended at levels above 5% in cucumber transplant production.

Key words: Growing medium, nutrient, porosity, seedling.

INTRODUCTION

For cultural and economic reasons transplants are used to establish many vegetables (Swiader et al., 1992; Vavrina and Summerhill, 1992) . The ability of a substrate to maintain adequate moisture and aeration is important (Bunt, 1976). Peat as a substrate benefits plant growth and reduces disease and other types of stress (Matkin and Chandler, 1957). However, peat is not a easily renewable resource and other substrates are being examined (Handar et al., 1985; Raviv et al., 1986; Verdock, 1988; Herrera et al., 2008). Organic residues such as urban solid wastes, sewage sludge, pruning waste, spent mushroom and green wastes, after proper composting, can be used in growth media to replace peat (Siminis and Manios, 1990 ; Pryce, 1991; García-Gómez et al., 2002; Benito et al., 2005). Municipal solid waste may be able to Kostewicz, 1992; Inbar et al., 1993). Herrera et al., 2008 reported that urban waste compost can be used for be used for vegetable transplant production. Municipal solid waste is approximately 60-90% biodegradable and might be used as a bulking material to absorb excess water, and supply a useful raw product for the horticulture industry. Numerous studies have addressed the use of compost in nursery plant production has been evaluated (Sanderson, 1980; Purman and Gouin, 1992; Roe and Kostewicz, 1992; Inbar et al., 1993). Herrera et al., 2008 reported that urban waste compost can be used for tomato (*Solanum lycopersicum* L.) transplant production. Cucumber (*Cucumis sativus* L.) is a crop that can also be started as transplants. There is no information on use of MSWC for cucumber transplant production. This study was conducted to determine the efficacy of mixing MSWC and peat in cucumber transplant production.

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MATERIALS AND METHODS

The experiments were conducted in a glass house of the agricultural faculty of Guilan University, Rasht, Iran in the spring of 2008. Average daily and night temperature were 27 ± 2 and 18 ± 2°C, respectively, with 65 - 75% relative humidity (Simon et al., 1976). Irrigation was supplied daily by hand. The treatments used

Table 1. Levels of some components found in peat and municipal solid waste compost.

Material	Organic matter (%)	pH	EC ($ds \cdot m^{-1}$)	Total N (%)	Ca (%)	K ($mg \cdot kg^{-1}$)	P ($mg \cdot kg^{-1}$)
Peat	90	6.5	1.5	1.3	10	166	880
MSWC	33	8.1	11.4	2.7	39	448	616

Table 2. ANOVA effects due to MSWC content on measured variables.

ns,*not significant, or significant at P < 0.01.

were: peat (100%)+MSWC (0%) control, peat (95%) +MSWC (5%), peat (90%)+MSWC (10%), peat (85%)+MSWC (15%) and peat (80%)+MSWC (20%) (by volume). Some characteristics of peat and MSWC were measured at the start of experiment using the methods of Gabriel et al. (1993) (Table 1). Assays of pH and EC were in a compost: water mix (1:5 v/v). The pH and EC were determined with a pH and EC meter (Euteoh, Singapore). Nitrogen content was measured on dry matter using the Kjeldahl method, phosphorus with a colorimetric spectrophotometer (model DU 640, Beckman, Fullerton, Calif.); calcium and by flame photometry (Latiff et al., 1996). Organic matter was determined after samples were ashed at 550°C (Gbolagade et al., 2006).

Seed were sown in the media on 10 Oct. 2008. Data were collected after appearance of cotyledons and included distance to cotyledons, stem diameter, leaf number, stem height, root length, ratio of stem diameter to stem height, fresh root and stem weights, dry root and stem weights and germination velocity (numbers of velocity (numbers of seed germinated 9 day after sowing). Rates of emergence were calculated using a modified Timpson's emergence velocity index: *G*/*t*, where *G* is the number of seeds emerged at 3-day intervals, and *t* is the total time of emergence.

The experiment was arranged in a completely random design with 5 treatments and 3 replicates with each replicate containing 10 plants. Data were subjected to analysis of variance in SAS (SAS, Inc., Cary, N.C.) and means separated using the Tukey test.

RESULTS AND DISCUSSION

Chemical characteristics of peat and municipal solid waste compost differed (Table 1). Values of pH, EC, Total N, Ca and K in MSW compost were greater, but peat had more organic matter and P (Table 1). The pH and EC values were lower than those of MSWC mixtures. ANOVA indicated that MSWC content affected results (Table 2). With the exception of distance to cotyledons and root dry weight, which were not affected, values of indices decreased as amount of MSWC increased (Figures 1 - 11). However, the cucumber transplants obtained of control treatment had highest values; the mixed treatment of peat (95%) +MSWC (5%) in many factors had not significance different with control, but other treatments were.

Also, result of correlation between the evaluated indices and MSWC content showed that have not liner relationship among distance to cotyledons, stem dry weight, root wet weight and root dry weight with MSWC, but there were in other indices. Stem height and MSWC content appeared highest correlation ($r^2 = 0.99$). Overall, there were negative correlations, mean increasing of MSWC content reduced amount of indices. Sanchez-Monedero et al. (2004) indicated that increased EC inhibit imbibitions of water and decreases germination. High EC can hinder transplant development (Kratky and Mishima, 1981; Herrera et al., 2008). Seedlings grown in the peat and peat+MSWC (5%) mixture displayed better quality and suitability for transplanting. Seedling resistance to transplant stress is directly related to dry matter content, which improves seedling establishment in the soil or growth substrate (Pimpini and Gianquinto, 1991).

Higher organic levels and ease of mineralization of nitrogen in peat may be responsible for better

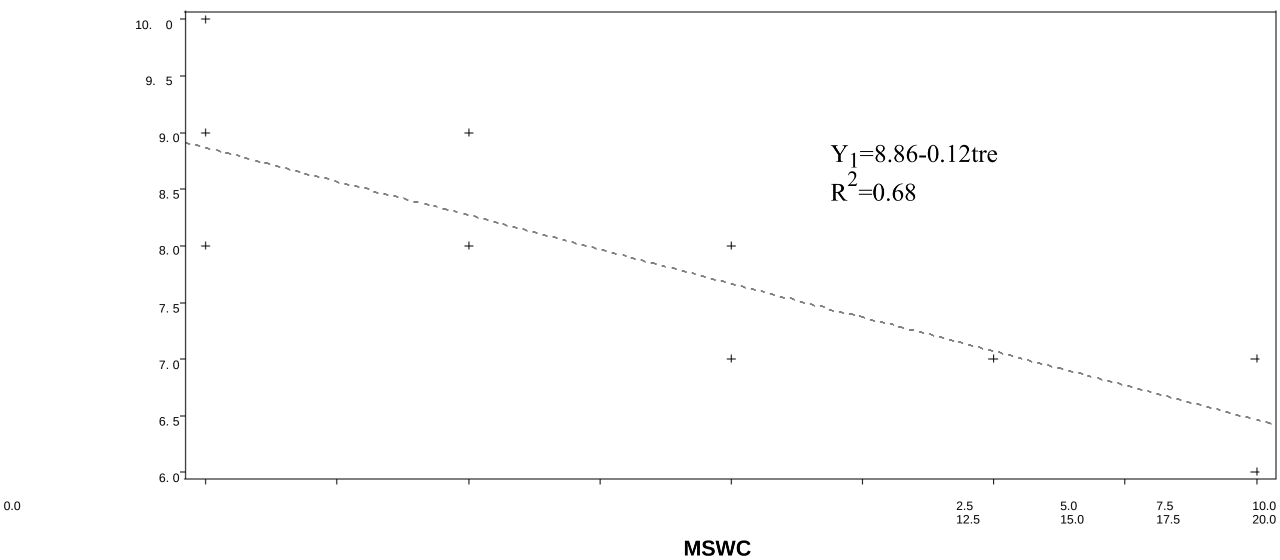

Figure 1. Relationship between germination velocity of cucumber transplants and MSWC content in medium.

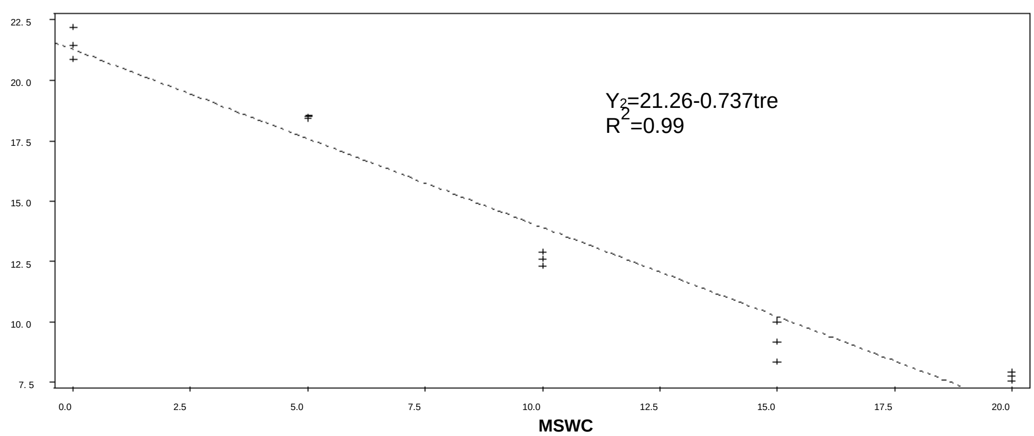

Figure 2. Relationship between stem height of cucumber transplants and MSWC content in medium.

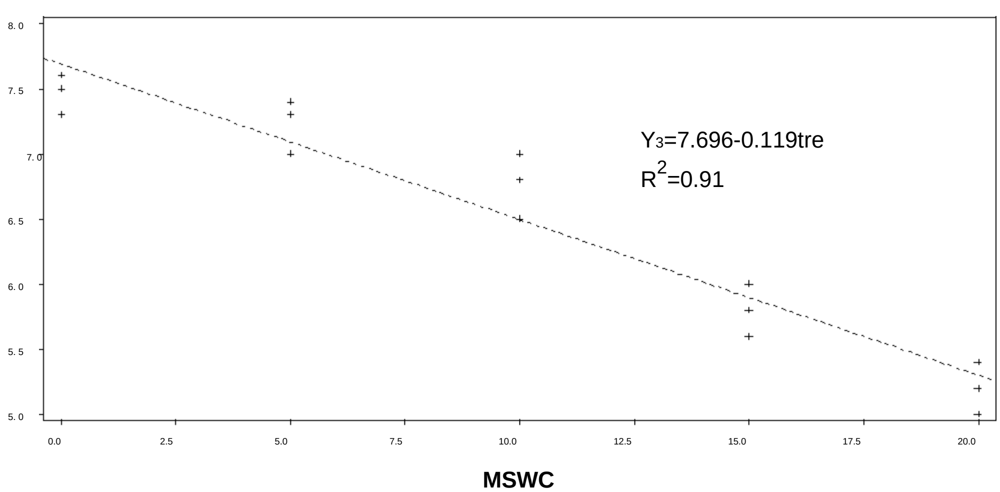

Figure 3. Relationship between leaf number of cucumber transplant and MSWC content in medium.

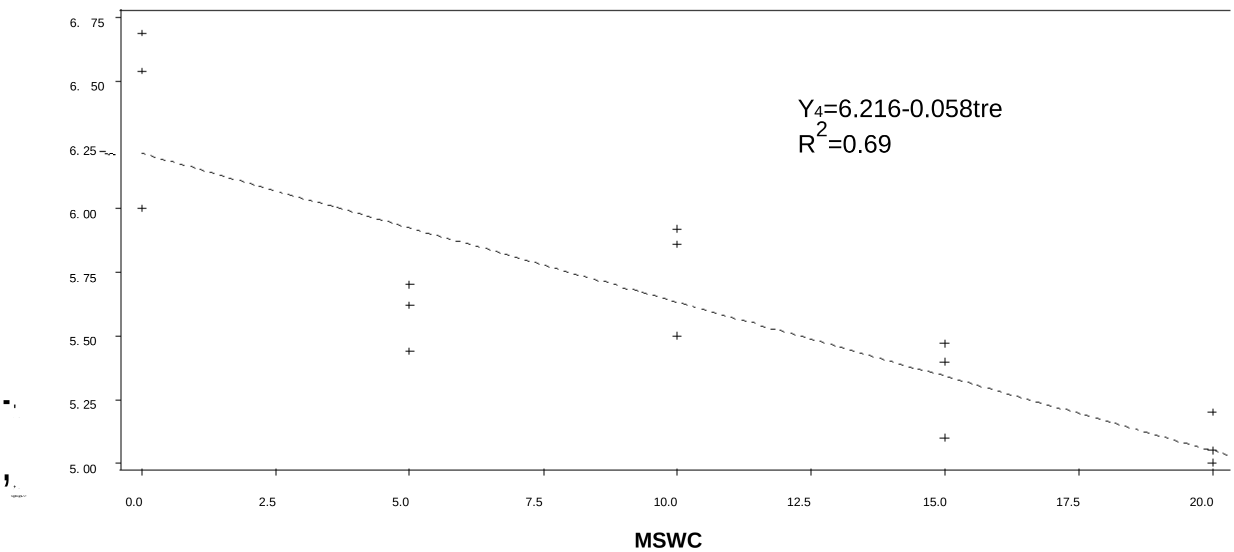

Figure 4. Relationship between stem diameter of cucumber transplant and MSWC content in medium.

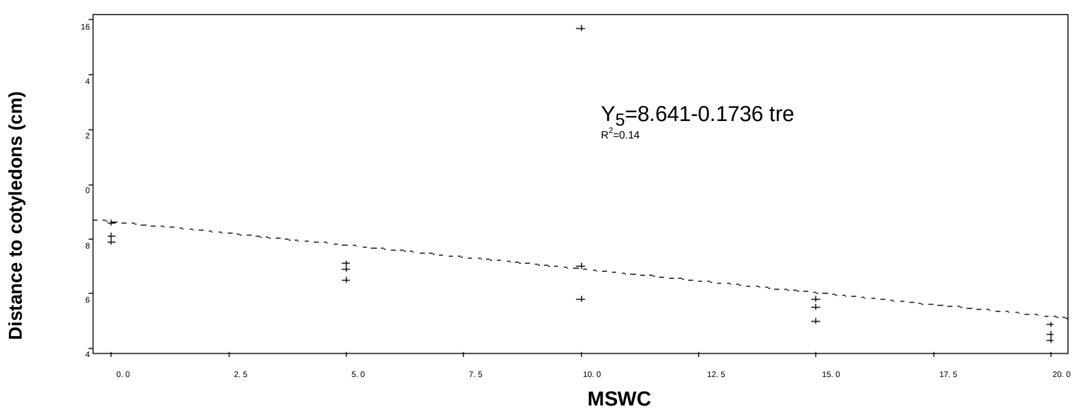

Figure 5. Relationship between distance to cotyledons of cucumber transplant and MSWC content in medium.

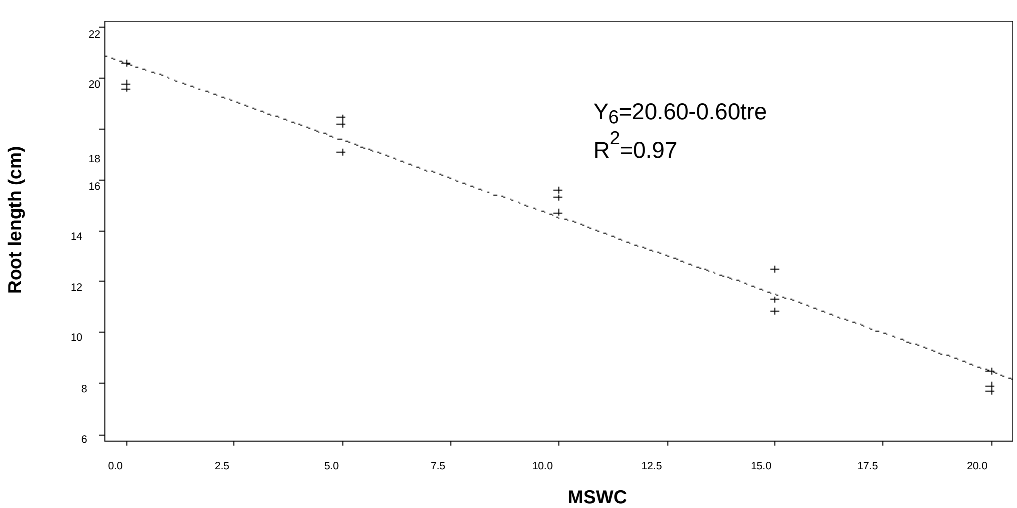

Figure 6. Relationship between root length of cucumber transplant and MSWC content in medium.

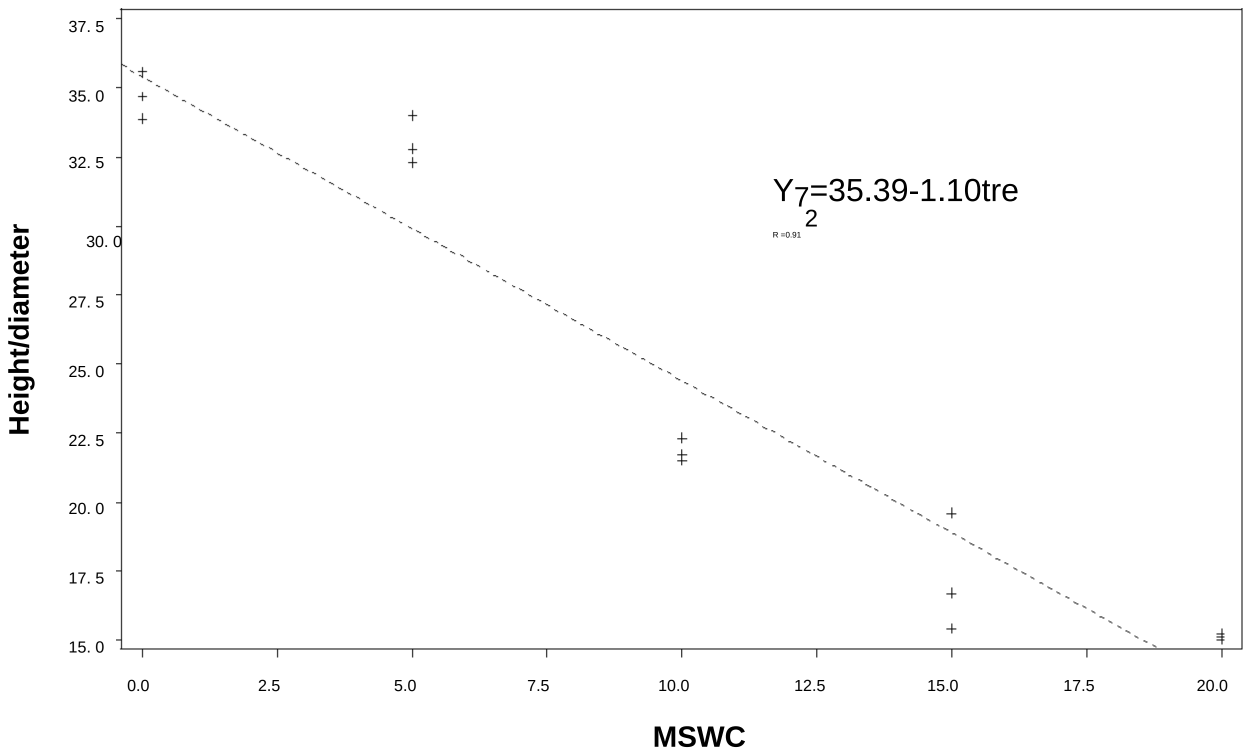

Figure 7. Relationship between height/diameter of cucumber transplant and MSWC content in medium.

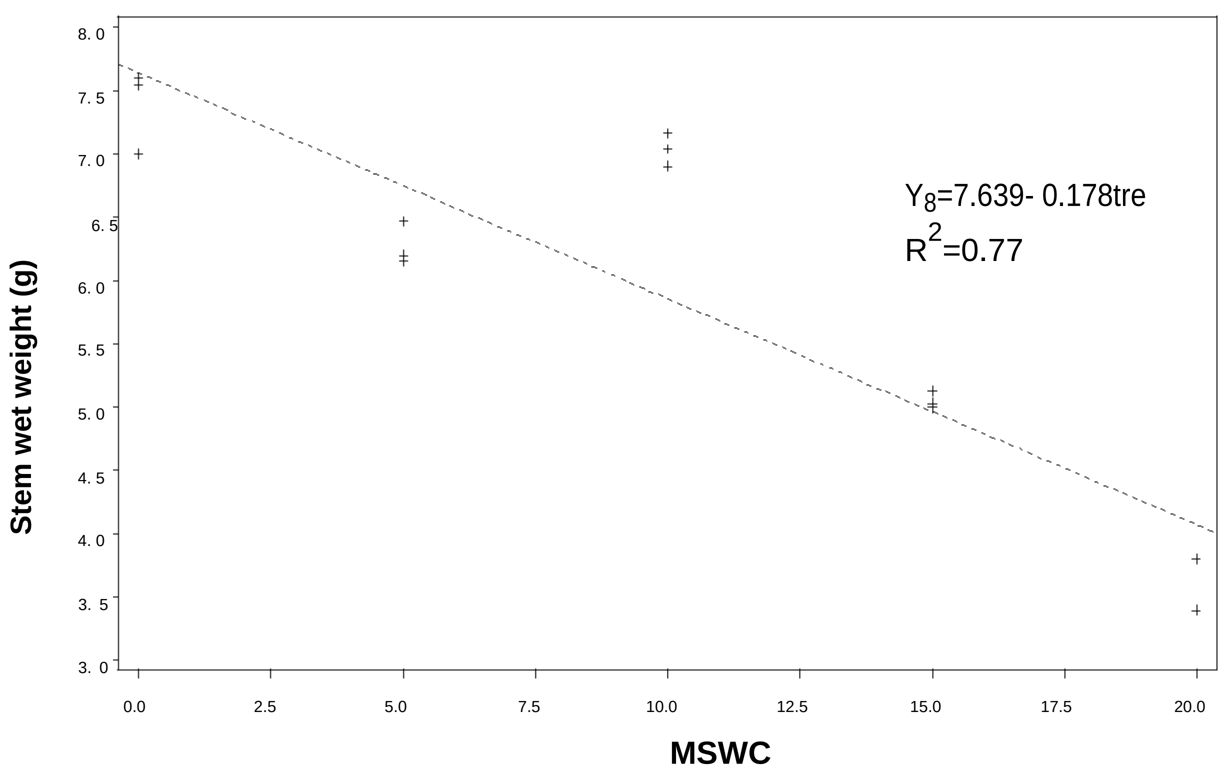

Figure 8. Relationship between stem wet weight of cucumber transplant and MSWC content in medium.

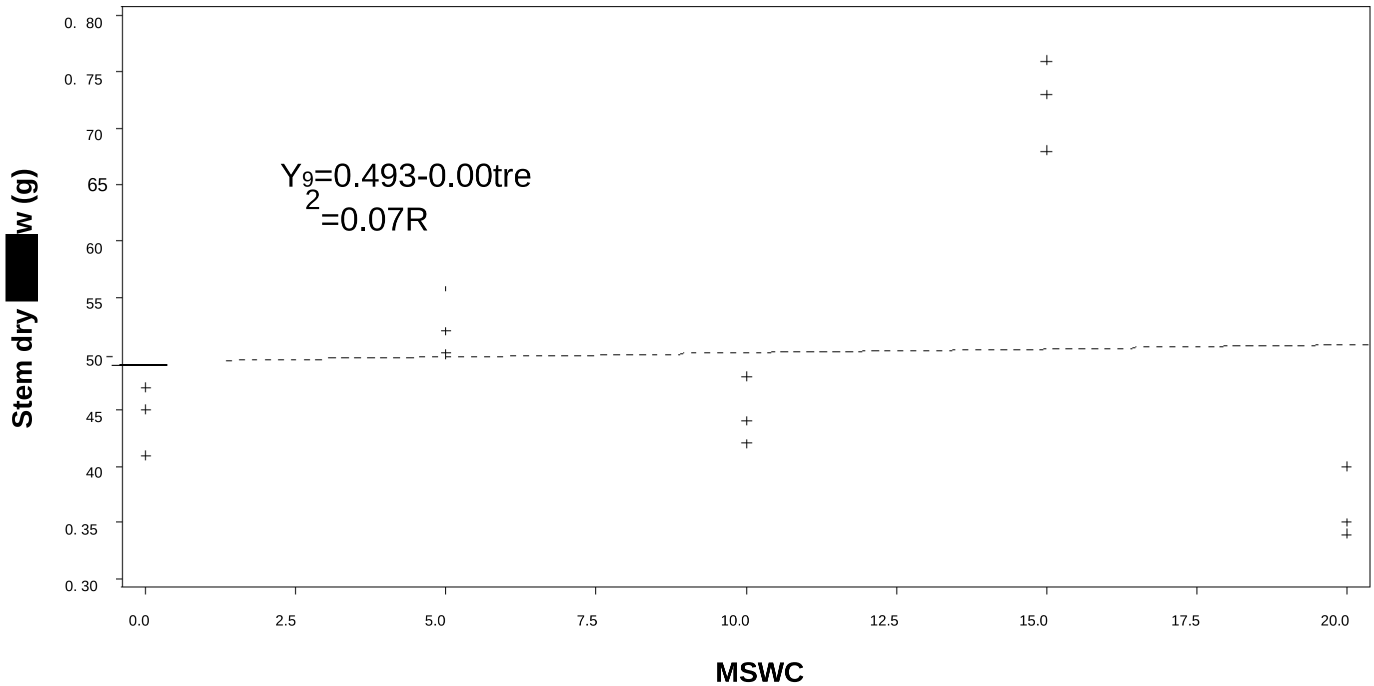

Figure 9. Relationship between stem dry weight of cucumber transplant and MSWC content in medium.

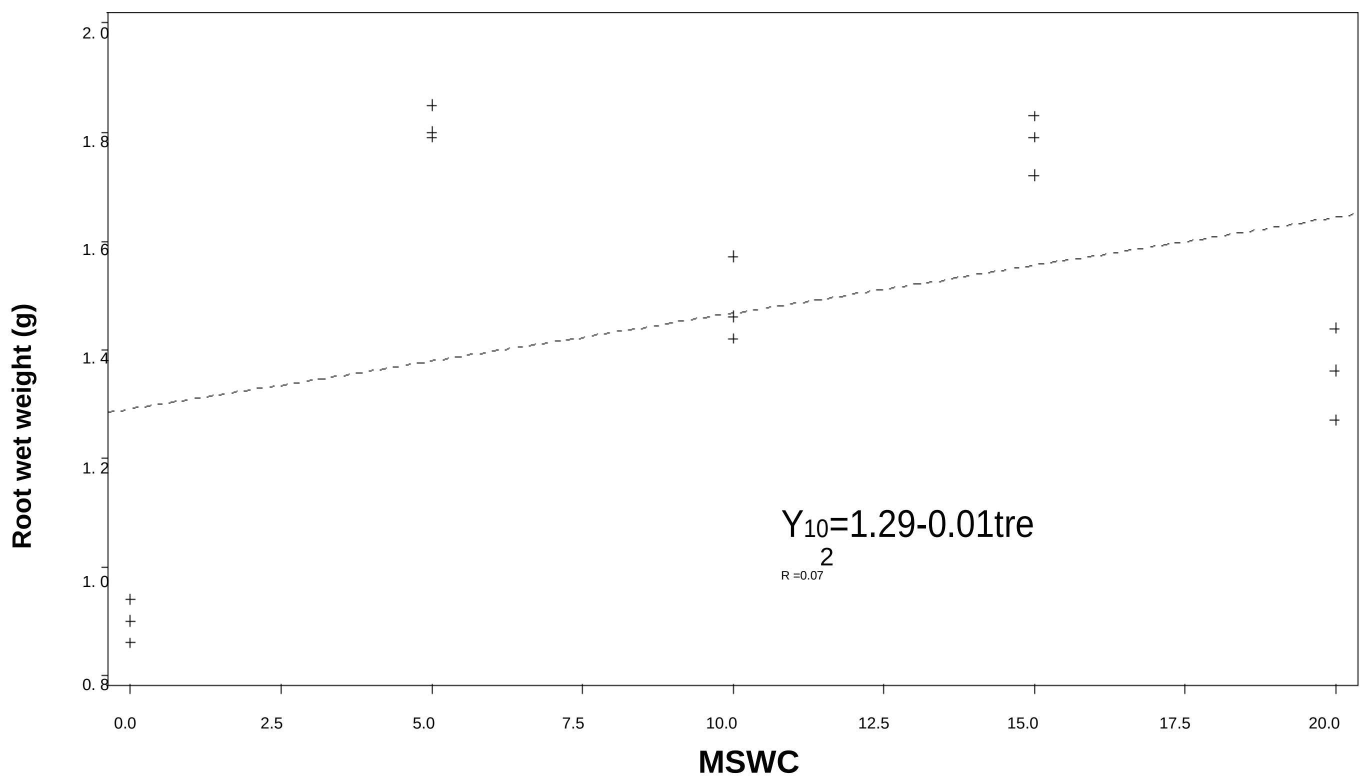

Figure 10. Relationship between root wet weight of cucumber transplant and MSWC content in medium.

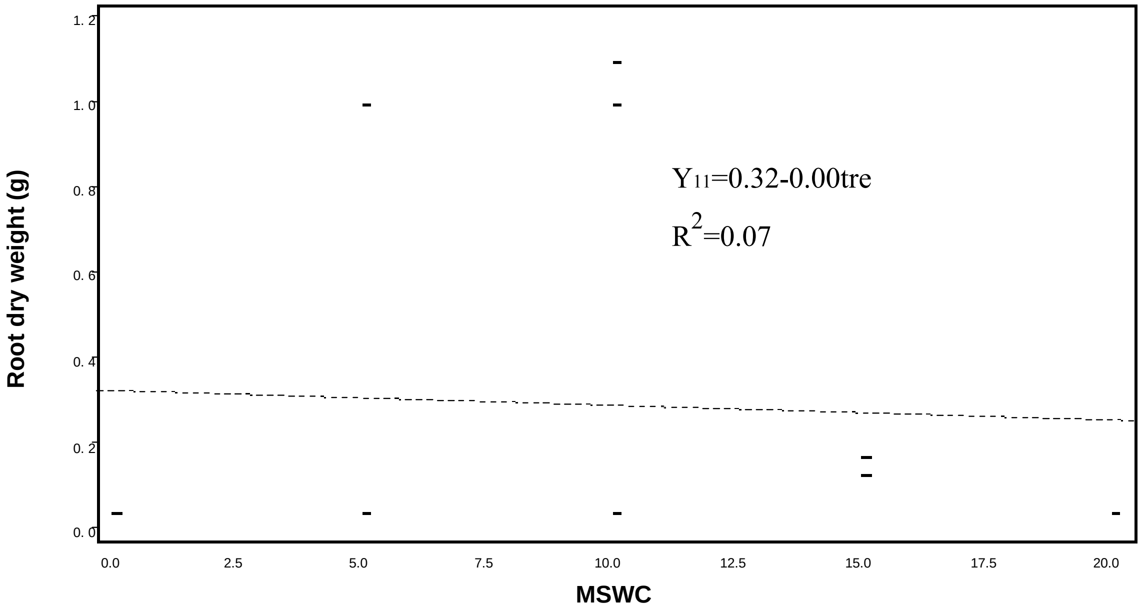

Figure 11. Relationship between root dry weight of cucumber transplant and MSWC content in medium.

response in relation of many vegetative indexes when compared to other treatments (Adegbidi and Briggs, 2003). The amount of MSWC used in cucumber transplant production should not exceed 5% by volume.

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