

Integrated weed management in damask rose (*Rosa damascena*) nursery

RAKESH KUMAR¹ AND RAKESH DEOSHARAN SINGH²

CSIR-Institute of Himalayan Bioresource Technology, Palampur, Himachal Pradesh 176 061

Received : September 2012; Revised accepted : July 2013

ABSTRACT

A field study was conducted at the experimental farm of CSIR-Institute of Himalayan Bioresource Technology, Palampur during 2008 and 2009 to assess the effect of different weed control methods viz., chemical, physical and cultural on weed management and growth rate of damask rose (*Rosa damascena* Mill.) nursery. Atrazine @ 1.0 and 2.0 kg/ha and metribuzin @ 0.75 and 1.50 kg/ha were applied as pre emergence in combination with one hand weeding at 4 months after planting. Both the herbicides were effective in reducing the weed population and biomass. Black polythene mulch was quite effective in controlling weeds, improving establishment and growth of nursery plants. Higher weed control efficiency (97.6%) next to weed free treatment was recorded in black polythene mulch as compared to other treatments. Use of black polythene mulch provided higher value of increased yield ($\text{₹}19.2 \times 10^5/\text{ha}$) while net income was higher due to application of atrazine @1.0 kg/ha+ 1 H.W. ($\text{₹}22.1 \times 10^5/\text{ha}$).

Key words : Damask rose, Economics, Nursery, Weed control

Damask rose is one of the most important aromatic, medicinal and ornamental plant, which is cultivated in many areas of the world for different products viz., rose oil, rose water, rose absolute and rose concrete etc. Rose oil production is approximately 5 t with Bulgaria and Turkey being the major producers followed by Morocco, Egypt, China, Russia, and Iran. India produces about 200 kg of rose oil and rose attars, in addition to a large quantity of rose water. In India, rose is mostly cultivated in northern states including Uttar Pradesh, Rajasthan, Jammu and Kashmir, Himachal Pradesh, Haryana, and some areas of Punjab in approximately 2500-3000 ha land (Shawl and Adams, 2009). Rose oil is commonly used in perfumery, cosmetics, beverages, soft drinks, ice-creams, and as a fragrance component in ointments and lotions etc. Besides its application in aromatic attributes, some valuable characteristics of damask rose oil such as anti-HIV, antibacterial and antioxidant activities (Ozkan *et al.*, 2004). Because of low oil content and lack of natural and synthetic substitutes, rose oil is one of the most expensive essential oils in the world markets (Kumar *et al.*, 2013).

Damask rose is mainly propagated by stem cutting. Successful establishment of hardwood cuttings usually

requires good site, weed control and other cultural practices to maintain adequate soil moisture and fertility during the growing season. Weed management is a major constraint in rose nursery because it has dense thorns. Application of farmyard manure in rose is general practice, which is a source of several weed seeds. Weeds interfere with the crop plants and severely reduced crop growth and quality (Calado *et al.*, 2010). For proper rooting and growth of the damask rose cuttings, it becomes imperative to control weeds in the nursery so that higher numbers of good quality plants are produced. In India, hand weeding is widely used for weed management. It is a laborious, time consuming and expensive method owing to scarcity of labour, particularly during the peak periods of labour demand. Moreover, hand weeding is not efficient in rose nursery as the rooted stem cuttings get disturbed along with weeds and the plant dies subsequently. Herbicides have been reported to be effective in reducing the weed growth and density in rose (Singh, 2005). Beneficial effects of black polythene mulch for weed control in different crops have also been reported (Mamkagh, 2009 and Halemani *et al.*, 2009). Though studies on weed management in damask rose (Singh and Singh, 2004) and ornamental rose (Singh, 2005) has been carried out earlier, studies in damask rose nursery is lacking. Therefore, the present investigation was undertaken to evaluate the efficacy of chemical, physical and cultural methods of weed control and determine the most economical method of

¹Corresponding author Email: rakeshkumar@ihbt.res.in; rakeshkran@yahoo.com

¹Senior Scientist, Natural Plant Products Division; ²Chief Scientist and Head, Biodiversity Division

weed control in damask rose nursery.

MATERIALS AND METHODS

Field experiments were conducted during 2008 and 2009 at the experimental farm of CSIR-Institute of Himalayan Bioresource Technology, Palampur (1393 m amsl, 32°06'05"N, 76°34'10"E), on clayey loam soil, which was acidic in reaction (pH 5.5), high in organic C (1.5%), medium in available N (244.6 kg/ha) and available K (171.5 kg/ha) and high in available P (36.4 kg/ha). Eight treatments comprising weedy check (control), weed free, black polythene mulch, hand weeding (HW) twice at 2 and 4 months after planting (MAP), atrazine @ 1.0 kg/ha + 1 hand weeding at 4 MAP, atrazine @ 2.0 kg/ha + 1 hand weeding at 4 MAP, metribuzin @ 0.75 kg/ha + 1 hand weeding at 4 MAP, metribuzin @ 1.5 kg/ha + 1 hand weeding at 4 MAP were laid out in randomized complete block design with three replications. Stem cuttings of 22.5 – 25.0 cm with 10 to 15 nodes/cutting of damask rose cv 'Jwala' were taken from the plantation at the farm of the institute. The lower portion of cuttings was treated with rooting hormone Indole Butyric Acid @ 500 ppm for 30 minutes and upper portion with fungicide bavistin @ 0.1% for 1 minute to protect from fungal diseases. The cuttings were planted immediately after treatment on 2 January 2008 and on 17 January 2009 at 15 cm x 10 cm spacing in a plot size 2.0 m x 1.5 m. The nursery was immediately irrigated after planting. Well rotten FYM @ 15 t/ha was incorporated in the soil one month before bed preparation. River sand was applied to the plot @ 0.05 m³/m². Application of 60 kg N+60 kg P₂O₅ +40 kg K₂O were made in the form of urea, single super phosphate and muriate of potash, respectively. Full dose of P and K and half dose of N were applied as basal, while remaining amount of N was applied after establishment of rose cuttings. Irrigation was applied as and when required to maintain proper moisture in the nursery. Plant protection measures were performed as per recommended package and practices for damask rose.

For physical mulching, 1 mm thick black polythene sheet was used. Black polythene was spread in the well prepared plots. Holes were made in polythene mulch with sharp edged iron at desired spacing and then rose cuttings were inserted inside the holes. In all treatments 2/3rd portion of the cuttings was inserted inside the soil and 1/3rd portion was placed above the soil surface. Cuttings were planted in a slanting position. Atrazine @ 1.0 and 2.0 kg/ha and metribuzin @ 0.75 and 1.50 kg/ha were applied as pre-emergence 1 week after planting. The herbicides were sprayed with knapsack sprayer with a flat-fan nozzle at a volume rate of 750 l water/ha. In weed free plots, first hand weeding was done at 1 MAP and subsequently at 15

days interval to maintain the plot weed free for entire growth period. The experiments were completed in August.

Observations were recorded on weeds, growth, plant survival and economics. For each measurement, weeds from the two areas per plot using a 0.25 m x 0.25 m quadrat were taken, broad leaved and narrow leaved weeds were counted. Weeds were uprooted; roots were washed and dried at 70°C until constant weight was achieved. In order to record growth parameters, 10 plants from each plot were selected, uprooted and data on plant height, number of branches/plant, number of leaflet/plant, number of primary roots/plant, number of bottom breaks (renewal shoot)/plant and dry root weight/plant was recorded. Soil temperature upto 10 cm depth was also recorded in bare and mulched soil at 2 PM every day.

The weed count and weed dry weight data were analyzed after transforming the actual data (×) to square root (×+1). Economics was calculated as per the existing price of input and output at local market. The price of rooted rose plant was taken as 10/rooted plant and cost of rose cutting was taken as ₹ 2/cutting.

RESULTS AND DISCUSSION

Survival of cuttings

Survival of stem cuttings after 1 month of planting varied from 61.4 to 88.0%. However, there was no significant difference among the treatments. It indicated that pre-emergence application of the herbicides had no adverse effect on survival of damask rose cuttings.

Soil temperature

Soil temperature was favourably influenced due to mulching. The soil temperature up to 10 cm soil depth was 23.7°C in the plots without mulch and +1.6°C in the plot mulched with black polythene sheet (Fig. 1). The temperature increase due to mulching has been reported earlier (Ban *et al.*, 2009). The enhancement of temperature under black polythene mulch was reported to be beneficial for fast mineralization of nutrients in soil (Nalayini *et al.*,

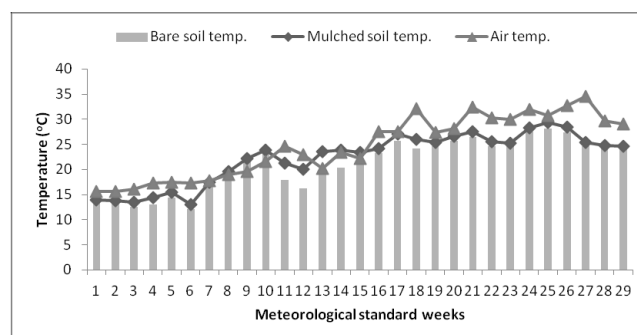


Fig. 1. Soil temperature under bare soil and mulched soil condition

2009) and mortality of weed seeds. Black polythene induced 2-3°C more soil temperature than bare soil due to higher rate of absorption of solar radiation.

Weed spectrum

Damask rose nursery plots were infested with broad leaved and narrow leaved weeds. The major weed species were *Chenopodium album*, *Coronopus didymus*, *Anagallis arvensis* *Melilotus indica*, *Vicia sativa*, *Polygonum alatum*, *Euphorbia* spp., *Gallinsoga parviflora* and *Plantago lanceolata* etc., while prevalence of *Avena fatua*, *Malva neglecta* and *Melilotus indica* was low. Singh (2005) also reported *C. album*, *A. arvensis*, *M. neglecta*, *M. indica* and *Polygonum* spp. as major weeds infesting ornamental rose.

Phytotoxicity symptoms on sprouted cuttings

Application of atrazine and metribuzin at lower doses caused no phytotoxicity but at higher dose phytotoxicity symptoms were observed. Atrazine @ 2.0 kg/ha and metribuzin @ 1.5 kg/ha initially caused light chlorosis in the leaves sprouted on the stem cuttings but later the plants recovered and showed good growth.

Weed population, biomass and weed control efficiency

All the weed control treatments proved effective in significantly reducing the number of the broad leaved weeds as compared to the weedy check (Table 1). Both herbicides and black polythene mulch were statistically comparable to the weed free in controlling broad leaved. However, these treatments were superior to hand weeding twice in controlling the broad leaved weeds. Black polythene mulch was quite effective in reducing the population of broad leaved weeds, which could be attributed to poor light conditions and physical suppression of the weeds. Similar findings were also reported by Ramakrishna *et al.* (2006) and Diaz-Perez *et al.* (2008).

All the herbicide treatments were statistically at par for the control of broad leaved weed population at 1 MAP. Atrazine 2.0 kg/ha +1 HW resulted in the lowest population of broad leaved weeds as compared to other treatments at 3 MAP. However, all the herbicides were statistically superior to weedy check in controlling broad leaved from 3 to 5 MAP. In black polythene mulch, the weeds emerged from the holes where the cuttings were inserted. Higher dose of these herbicides remained at par with black polythene mulch and weed free treatment. Singh (2005) also reported efficient control of non-grass weeds using atrazine and metribuzin in ornamental rose field.

At 1 MAP, narrow leaved weeds were significantly controlled by different weed control treatments as compared to weedy check and hand weeding twice. Later,

Table 1. Effect of different weed management practices on weed population at different stages of observation and weed control efficiency (Pooled data of two years)

Treatment	Broad leaved weeds (No./m ²)			Narrow leaved weeds (No./m ²)			Total weed population (No./m ²)			Total weed dry weight (g/m ²)			Weed control efficiency at 5 MAP (%)	
	1 MAP*	3 MAP	5 MAP	1 MAP	3 MAP	5 MAP	1 MAP*	3 MAP	5 MAP	1 MAP	3 MAP	5 MAP		
Weedy check	14.4(261.3)	17.6(314.0)	18.6(347.3)	12.2(178.7)	15.3(233.3)	15.5(240.7)	20.9(440.0)	23.4(547.3)	24.2(588.0)	3.6(13.3)	17.5(309.7)	18.2(335.6)	-	-
Weed free	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	100.0	100.0
Black polythene mulch	1.0(0.0)	2.0(5.3)	2.0(5.3)	1.0(0.0)	1.0(0.0)	1.0(0.0)	1.0(0.0)	2.0(5.3)	2.0(5.3)	1.0(0.0)	1.8(3.6)	2.3(7.9)	97.6	97.6
Hand weeding twice	7.7(104.0)	8.4(77.3)	5.3(32.0)	4.5(32.7)	7.5(58.7)	7.8(69.3)	8.8(136.7)	11.4(136.0)	9.7(101.3)	2.6(8.7)	7.0(48.2)	4.7(26.3)	92.2	92.2
Atrazine @ 1.0 kg/ha + 1 hand weeding at 4 MAP	1.0(0.0)	4.9(32.0)	3.8(18.7)	1.0(0.0)	10.5(112.0)	8.8(80.0)	1.0(0.0)	12.0(144.0)	9.9(98.7)	1.0(0.0)	7.1(50.2)	6.3(57.2)	82.9	82.9
Atrazine @ 2.0 kg/ha + 1 hand weeding at 4 MAP	1.0(0.0)	2.8(10.7)	1.0(0.0)	1.0(0.0)	8.0(64.0)	7.9(64.0)	1.0(0.0)	8.6(74.7)	7.8(64.0)	1.0(0.0)	5.0(28.6)	4.8(27.9)	91.7	91.7
Metribuzin @ 0.75 kg/ha + 1 hand weeding at 4 MAP	1.0(0.0)	4.9(26.7)	6.1(38.7)	1.0(0.0)	10.1(106.7)	6.6(45.3)	1.0(0.0)	11.4(133.3)	9.2(84.0)	1.0(0.0)	6.7(43.6)	6.5(62.3)	81.4	81.4
Metribuzin @ 1.5 kg/ha + 1 hand weeding at 4 MAP	1.0(0.0)	4.1(18.7)	2.6(10.7)	1.0(0.0)	7.3(53.3)	8.1(66.7)	1.0(0.0)	8.5(72.0)	8.7(77.3)	1.0(0.0)	3.3(10.6)	3.8(18.5)	94.5	94.5
SEm±	0.3	0.8	0.6	0.3	0.4	0.6	0.3	0.7	0.5	0.1	0.6	0.8	0.8	0.8
CD (P=0.05)	1.0	2.3	1.8	0.9	1.3	1.7	0.9	1.9	1.6	0.2	1.6	2.2	2.2	2.2

black polythene mulch significantly reduced the population of narrow leaved weeds over all other treatments at 3 and 5 MAP (Table 1). Atrazine and metribuzin at higher doses remained statistically at par with each and resulted in significantly lower population of narrow leaved weeds as compared to other herbicide treatments at 3 MAP. Singh (2005) also reported similar findings regarding control of narrow leaved weeds by atrazine.

The different weed control treatments were effective in controlling total weed population and reducing total weed biomass at all the stages of observation (Table 1). Black polythene mulch reduced the total weed population as compared to other treatments at all the stages of observation. Among the herbicide treatments, application of atrazine @ 2.0 kg/ha + 1 HW resulted in significantly lower total weeds than weedy check. However, it was statistically at par with metribuzin @ 1.5 kg/ha + 1 HW, at 3 MAP and 5 MAP. At 1 MAP, all the chemical treatments significantly reduced the total weed dry weight as compared to other treatments. At 3 MAP black polythene mulch resulted in significantly lower total weed dry weight. Singh (2005) also reported reduction in weed dry biomass by using herbicides in rose.

Black polythene mulch resulted in higher weed control efficiency (97.6%) next to weed free treatment (100%). Among different chemical treatments, metribuzin @ 1.5 kg/ha + 1 HW resulted in higher weed control efficiency (94.5%) followed by atrazine @ 2.0 kg/ha + 1 HW (91.7%). This was due to better weed control by different weed control treatments (Table 1). Goswami and Saha (2006) also reported higher weed control efficiency by black polythene mulch.

Growth and yield attributes

Black polythene mulch resulted in significantly higher number of branches/plant, leaflets/plant, plant height, root length, number of primary roots, number of bottom breaks, dry root weight due to less competition offered by weeds (Table 2). Black polythene mulch was effective in better weed control and moisture conservation (Ramakrishna *et al.*, 2006; Diaz-Perez *et al.*, 2008) which lead to better growth and increased number of leaflets. Singh (2005) has also reported reduction in the number of branches in rose due to weed competition. Black polythene mulch resulted in significantly longer root length (20.5 cm) which was at par with weed free and atrazine @ 1.0 kg/ha + 1 HW, atrazine @ 2.0 kg/ha + 1 HW and metribuzin @ 1.5 kg/ha + 1 HW (Table 2). Longer root length due to mulching was reported by Nayalini *et al.* (2009). Likewise higher number of bottom breaks were observed in black polythene mulch followed by atrazine @ 2.0 kg/ha + 1 HW, metribuzin @ 1.5 kg/ha

Table 2. Growth parameters of damask rose and economics of different weed control methods as affected by different treatments (Pooled data of two years)

Treatment	Number of branches/ plant	Number of leaflets/ plant	Plant height (cm)	Root length (cm)	Number of primary roots/ plant	Number of bottom breaks/ plant	Dry root weight (g/plant)	Plant survival (%)	Cost of cultivation ($\times 10^5$ ₹/ha)	Net profit ($\times 10^5$ ₹/ha)	B:C ratio	Value of increased yield ($\times 10^5$ ₹/ha)	Increased net benefit over weedy check ($\times 10^5$ ₹/ha)
Weedy check	1.7	19.7	29.2	12.2	5.8	10.3	0.4	36.2	9.7	4.4	1.5	0.0	0.0
Weed free	2.7	75.7	68.5	18.7	8.7	18.9	1.9	79.0	10.7	20.1	2.9	16.7	15.3
Black polythene mulch	3.1	81.4	79.9	20.5	15.3	23.6	2.4	85.3	12.6	20.7	2.6	19.2	16.0
Hand weeding twice	2.7	69.0	62.2	15.4	9.1	18.2	1.3	73.6	10.1	18.5	2.8	14.6	13.4
Atrazine @ 1.0 kg/ha + 1 hand weeding at 4 MAP	2.9	75.1	60.0	17.3	8.5	19.1	1.4	82.6	10.1	22.1	3.2	18.1	17.4
Atrazine @ 2.0 kg/ha + 1 hand weeding at 4 MAP	2.5	69.0	62.2	19.0	7.8	22.4	1.6	75.6	10.0	19.5	2.9	15.4	14.7
Metribuzin @ 0.75 kg/ha + 1 hand weeding at 4 MAP	2.5	60.5	65.3	17.1	9.2	17.3	1.7	80.2	10.0	21.2	3.1	17.2	16.5
Metribuzin @ 1.5 kg/ha + 1 hand weeding at 4 MAP	2.2	68.9	65.4	17.7	7.7	20.2	1.7	81.0	10.1	21.5	3.1	17.5	16.8
SE $\pm$	0.2	6.3	3.6	1.1	0.8	1.5	0.2	2.1					
CD (P=0.05)	0.7	18.3	10.5	3.2	2.3	4.5	0.7	6.1					

MAP: Months after planting; Cost of planting material = ₹2/cutting; Price of rooted rose plant ₹10; Cost of variable: atrazine 50WP = ₹680/kg; metribuzin = ₹2,568/kg; Labour charge = ₹160/man day; Black polythene sheet = ₹22.5/m²

+ 1 HW, atrazine @ 1.0 kg/ha + 1 HW. Black polythene mulch recorded significantly higher dry root weight than other herbicide treatments. It was statistically at par with weed free and metribuzin @ 0.75 kg/ha + 1 HW (Table 2). All other herbicide treatments remained at par with each other but recorded significantly more root dry weight than weedy check. Mulching avoided the fluctuations in temperature in the top 20-30 cm depth in soil. This favoured root development as the soil temperature in the planting bed was raised for faster crop development (Lamont, 1999).

Plant survival

Black polythene mulch was statistically at par with atrazine @ 1.0 kg/ha + 1 HW, metribuzin @ 0.75 kg/ha + 1 HW, and metribuzin @ 1.5 kg/ha + 1 HW in improving higher plant survival (Table 2). Weedy check showed significantly lowest plant population at harvest, which was due to more weed competition (Table 1). Plant survival in weed free and hand weeding plots was low as compared to black polythene mulch and herbicide treated plots due to disturbance in rooting zone.

Economics

All the weed control treatments gave considerably higher net profit over weedy check (Table 2). Higher net returns were recorded in atrazine @ 1.0 kg/ha + 1 HW followed by metribuzin @ 1.50 kg/ha + 1 HW, metribuzin @ 0.75 kg/ha + 1 HW and black polythene mulch. The reduction in net profit due to black polythene mulch was due to high input cost of the polythene sheet. Higher benefit cost ratio (3.2) was recorded in atrazine @ 1.0 kg/ha + 1 HW.

It was evident that use of black polythene mulch is beneficial for controlling the weeds, enhanced performance of rose cuttings and higher returns. Among herbicides, application of atrazine @ 1.0 kg/ha + 1 HW was found effective in reducing weed population and resulted in higher economic returns.

REFERENCES

- Ban, D., Zanic, K., Dumcic, G., Culjak, G.T. and Ban, G.S. 2009. The type of polyethylene mulch impacts vegetative growth, yield and aphid populations in watermelon production. *Journal of Food, Agriculture and Environment* 7: 543–50.
- Calado, J.M.G., Basch, G. and Mario, de. Carvalho. 2010. Weed management in no-till winter wheat (*Triticum aestivum* L.). *Crop Protection* 29: 1–6.
- Diaz-Perez, J.C., Phatak, S.C., Ruberson, J., Silvoy, J. and Morse, R. 2008. Utilization of mulches increase yield and improve weed control in no-till organic broccoli. (In:) *Proceedings of the 30th Southern Conservation Agricultural Systems Conference* 29–31 July, Tifton, Georgia.
- Goswami, S.B. and Saha, S. 2006. Effect of organic and inorganic mulches on soil-moisture conservation, weed suppression and yield of elephant-foot yam (*Amorphophallus paeoniifolius*). *Indian Journal of Agronomy* 51: 154–56.
- Halemani, H.L., Hugar, A.Y., Aladakatti, Y.R. and Nandagavi, R.A. 2009. Studies on the effect of polyethylene mulching on cotton genotypes under rainfed conditions. I. Influence on growth, yield components and seed cotton yield. *Karnataka Journal of Agricultural Science* 22: 280–83.
- Kumar, R., Sharma, S., Sood S. and Agnihotri, V.K. 2013. Agonomic interventions for the improvement of essential oil content and composition of damask rose (*Rosa damascena* Mill.) under western Himalayas. *Industrial Crops and Products* 48: 171–77.
- Lamont, W.J. 1999. The use of different coloured mulches for yield and earliness. (In:) *Proceedings of the New England Vegetable and Berry Growers Conference and Trade Show*, Sturbridge, Mass, pp. 299–02.
- Mamkagh, A.M.A. 2009. Effect of tillage time and plastic mulch on growth and yield of okra (*Abelmoschus esculentus*) growth under rainfed conditions. *International Journal of Agriculture and Biology* 11: 453–457.
- Nalayini, P., Anandham, R., Sankaranarayanan, K. and Rajendran, T.P. 2009. Polyethylene mulching for enhancing crop productivity and water use efficiency in cotton (*Gossypium hirsutum*) and maize (*Zea mays*) cropping system. *Indian Journal of Agronomy* 54: 409–14.
- Ozkan, G., Sagdic, O., Baydar, N.G. and Baydar, H. 2004. Antioxidant and anti bacterial activities of *Rosa damascena* flower extracts. *Food Science and Technology International* 10: 277–81.
- Ramakrishna, A., Tam, H.M., Wani, S.P. and Long, T.D. 2006. Effect of mulch on soil temperature, moisture, weed infestation and yield of groundnut in northern Vietnam. *Field Crops Research* 95: 115–25.
- Shawl, A.S. and Adams, R. 2009. Rose oil in Kashmiri India- An emerging cash crop benefiting industry and local agribusiness. *Perfumer and Flavorist* 34: 2–5.
- Singh, A. and Singh M. 2004. Weed management in essential oil yielding damask rose (*Rosa damascena*). *Journal of Medicinal and Aromatic Plant Sciences* 26: 721–26.
- Singh, A.K. 2005. Effect of management practices on weed dynamics, leaf nutrient status and flower yield in rose. *Indian Journal of Horticulture* 62: 375–77.