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2011 Final Report for
Oregon Nursery Research Regulatory Committee of ODA

Testing Soil Additives to Increase Plant Survival/Growth

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Project Background

There are numerous materials that can be added to the soil or drenched on roots during planting. Generally, product claims focus on alleviation of plant water stress, improved nutrient uptake/root growth, improved soil water holding capacity or some combination of the three.

This project evaluated noble fir field and container plantings and nursery planting of hydrangeas and barberries to determine if various commonly available additives could be used to improve survival, growth or both.

Most conifer plantings for Christmas trees do not receive supplemental watering after planting, so any boost in additional plant available water through the summer-fall should improve survival rate and minimize replanting expenses. Likewise, any boost in initial plant growth could provide improvement in time or size to market for nursery crops as well as field conifer plantings. Barberries and hydrangeas were the species selected for nursery site testing as these appeared to suffer from higher mortality than others species at this nursery site.

Materials and Methods

The product additives tested in this trial are listed in table 1. In general, they break down into 3 treatment types:

1. Root dips (Zeba and Rootex)
2. Mycorrhizal fungi additives (ectomycorrhizae and arbuscular mycorrhizae)
3. Geohumus (a gel forming polyacrylamide) additive.

The types of sites and plants used in the experiment were:

1. Non-irrigated noble fir field Christmas tree plantings (3 locations);
2. Irrigated nursery sites with hydrangea and barberries (2 fields);
3. Irrigated container trial with noble fir (1 location).

Noble fir Sites-

The noble fir planted at all sites were identical. These were 2 yr. old 10 cu. in. plug seedlings grown by Kintigh Mountain Home Nursery. Planting occurred in Feburary-May. Survival and final growth measurements were made in late September through October, after the 2011 growth was complete. On the conifer plantings, the root dips occurred just prior to planting and the other additives were included during the planting process. Treatements were randomized within 5 reps; each rep included 10 trees/treatment for a total of 50 trees for each treatment/site and a grand total of 300 experiment trees for each of the three sites.

Final evaluation for conifers included measurements of plant height, leader length, stem caliper, color (1-5, with 5 the best) and a yes/no evaluation of lammas growth occurring anywhere along the leader.

Nursery Sites-

Bailey Nursery at Sauvies Island provided the nursery location. Soil there was a silt loam, and the planting of both hydrangea and barberries was conducted with a planting machine. For all treatments, including the control, plants were dug up, treated and replanted immediately following machine planting. Planting and treatment occurred in the last week of May and evaluation on September 30, 2011. On this location, blocks of 18 plants were treated (3 rows X 6 trees). Each block was replicated 5 times for a totals of 90 plants per treatment and 540 plants total per species.

Final evaluations included the following: Plant height, plant width 1 (widest), plant width 2 (90 degrees from the widest measure) and a count of new shoots emerging from the plant base. A Growth Index was calculated for barberry and hydrangea using the formula (ht+ width 1+ width 2)/3.

All Sites

At all sites, three plants from each treatment were dug up and delivered to Plant Health LLC in Albany for evaluating of root and shoot fresh biomass and mycorrhizae colonization. The colonization values were: 0= none, 1= 1-10%, 2= 11-25% and so on.

Table 1. Treatment summary –all sites.

Code/Color tag	Species in test	Product/Treatment	Rate Used
1. Stripe/black	All	Untreated Check	none
2. White	All	Geohumus	2 T/plant
3. Blue	All	Geohumus+Ectomychorrizae	2T/plant
4. Yellow	Conifers & Barberry	Ectomychorrizae	2T/plant
	Hyrangea	Arbuscular mycorrhizae	1T/plant
5. Green	All	Zeba	36g/4gal H2O
6. Red	All	Rootex	1#/5-gal H2O

Results

For reporting purposes, results will be summarized first for above ground measurements and then for below ground/plant mass and colonization observations.

Mortality

There were over 900 noble fir seedlings in the study and only 35 that died during this study. These were evenly divided between the three farms and without any meaningful separation between treatments. The 2011 growing season was without any long hot or dry period with good rainfall; in other words a poor year to measure mortality.

The barberries and hydrangea were irrigated frequently. Some mortality was evident, but in very low numbers and not related to treatment. The mortality that was observed appeared to be related to field position and weed stress.

Growth

Above ground growth in the Christmas trees is summarized in table 2. Of all the treatments, the rootex root dip showed marginally better average growth, but this was largely due to improved growth at one site for reasons still unknown.

Table 2. Growth- all Christmas tree sites

Treatment	Values Ave. Ht. (cm)	Ave. Caliper-mm	Ave. Color	Ave. Leader length (cm)
1	32.4	6.0	3.7	10.7
2	31.9	6.4	4.1	11.4
3	31.8	6.4	4.0	12.0
4	31.0	6.2	3.6	10.8
5	30.9	6.1	3.7	10.8
6	33.9	6.7	3.8	14.3

There was large growth difference between the farms as shown in table 3. Trees at the Stroda farm were far larger than the other 2 sites. The difference in this case is likely the “milk carton effect“ on the Stroda farm as all the trees here were enclosed in open milk cartons to reduce rabbit damage. The resulting growth was likely a miniature hot house or light barrier impact and trees at this site were taller without any increase in caliper.

Table 3. Average Growth of Noble fir by Farm

Farm	Values Ave. Ht (cm)	Ave. leader length (cm)	Ave. Caliper-mm
Heritage	26.4	8.2	5.4
LTF	30.2	7.0	7.1
Stroda	39.3	19.8	6.4

Lammas growth was tallied at all the Christmas tree fields and is summarized in table 4. There are large differences in these values but differences were not related to treatment. Typically, lammas growth is caused by late season rainfall. Heritage tree farm was the last location planted and it is possible that root development was delayed and lammas growth was minimal. It is also possible that the milk cartons used at the Stroda site encouraged late season plant growth.

Table 4. # of trees with lammas growth

Farm	# Trees with Lammas growth
Heritage	3
LTF	77
Stroda	175

Table 5 below summarizes the average growth for the Sauvies Island site. There does not appear to be any treatment differences.

Table 5. Barberry and Hydrangea Growth Summary

Species	Treatments	Values Ave. Ht (cm)	Ave. # of shoots	Ave. Growth Index
Barberry	1	19.4	2.9	17.9
Barberry	2	19.1	3.1	20.9
Barberry	3	21.2	3	21.8
Barberry	4	20.9	3.2	22.6
Barberry	5	19	2.6	16.1
Barberry	6	16.1	2.8	15.7
Hydrangea	1	24.2	4.1	30.9
Hydrangea	2	20.8	3.5	25.4
Hydrangea	3	24	4.1	32.6
Hydrangea	4	24.6	3.7	29.7
Hydrangea	5	25.7	4.3	34.5
Hydrangea	6	24.5	3.9	31.9

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Root/shoot mass and % mycorrhizae colonization evaluations were conducted by PlantHealth LLC.. Average values from the three plants used in the evaluation are shown in Tables 6 and 7 below. With the limited number of plants (3/treatment) for evaluation, statistical evaluation is impossible.

Table 6. All Christmas tree sites- Root/shoot mass and colonization rating.

Treatments	Ave. root mass (g)	Ave. shoot mass (g)	% Ecto Colonization Rating
1	14.7	22.9	.7
2	21.8	28.6	.3
3	18.9	28.3	.1
4	24.8	35.4	.4
5	22.7	23.7	.9
6	34.9	31.9	.3

The very low levels of ectomycorrhizae found in the samples after the first growing season appear to not be a significant to influence growth of plug transplants.

Table 7. Ave. Root/shoot mass, AM colonization by treatment (Nursery site)

Species	Treatment	Ave. Root mass (g)	Ave. Shoot mass (g)	% AM colonization
Hydrangea	1	109	100	1
Hydrangea	2	171	92	1
Hydrangea	3	115	68	.3
Hydrangea	4	115	78	1.7
Hydrangea	5	99	90	1
Hydrangea	6	102	57	.7
Barberry	1	5	4	None
Barberry	2	11	6	None
Barberry	3	7	5	None
Barberry	4	11	10	None
Barberry	5	8	6	None
Barberry	6	2	4	None

The % colonization for hydrangea showed a low level of AM structures perhaps from a low level of inoculum present in the soil, but that very little infection occurred during the first growing season. Barberry appears not to form arbuscular mycorrhizae (AM). The literature reports however are not conclusive (Linderman, Personal Communication).

Conclusions

Plant mortality was not influenced by treatment. For Christmas tree fields, 2011 weather proved to be a poor year to test drought response. Rain was plentiful, mortality low. The hydrangea and barberry fields were irrigated frequently to insure plant survival.

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Christmas tree growth was largely unrelated to treatment though on one site the Rootex dip produced marginally larger trees. The Stroda site had taller seedlings due to grower practice to control rabbit browse by installing open milk carton seeding enclosures. No root treatments showed differences.

Little differences were found in the root and shoot mass for any of the species and sites tested.

The mycorrhiza part of the treatments appears to have had little effect, due at least in part, that it was not a year with significant drought.