again (as before when cutting grafts were made) *j. canaerti, J. glauca, J. burki* which are, if not dead, only 2 feet tall, while all other upright varieties are 5′ on an avearge. spreaders have reached as much as 3′ in *J. squamata meyeri.*

On all three trial understocks we found that the roots of all *J. chinensis* are reasonable to good, while the roots of the 3 *J. virginiana* varieties which grew well are very coarse while the 3 *J. virginiana* which showed signs of incompatability with *J. pseudocupressus* have kept the fine root system of the understock *J. pseudocupressus.* I would at this point suggest there is, as in many other plants, a definite influence between scion and understock and which has been well documented in the case of fruit trees and their respective vegetative propagated understocks (E. M. and M.M. clones for Malus and the various Quince types for Pyrus. Plum clones for plums and peaches). We still feel the ease of propagation and transplanting outweighs any drawbacks we might encounter and makes it worthwhile for us to continue to use these understocks. The main point in favour being their resistance to disease and very high percentage of success in grafting.

MODERATOR HESS: Thank you, Joerg, for an excellent presentatation. The balance of this afternoon's program will deal with weed control and will be moderated by Roger Coggeshall.

MODERATOR COGGESHALL: Our subject of weed control is one we are all interested in. It is a controversial subject. As you know some people are successful, others are not. We are fortunate this afternoon in having two men to speak to us. The first I would like to introduce is Dr. Alfred Pridham, Cornell University, Ithaca, New York.

WEED CONTROL FOR THE NURSERY

ALFRED M. S. PRIDHAM
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Cornell University
Ithaca, New York

Weed — A weed is a plant out of place or an unwanted plant.

Some weeds carry plant diseases and insect pests while the mere presence of quackgrass in a plant ball is enough to restrict trade by quarantine in some states.

It is now 20 years since the selective action of "Carrot spray" was found to apply to the weeding of evergreen seed beds and that Dinitro killed seedling weed growth promptly on contact but that woody stems were merely defoliated.

Large scale soil fumigation was in use 20 years ago in production of Hawaiian Pineapples and mulch paper was laid by machine. Young cuttings or offsets of pineapples were set through the paper mulch and early growth proceded with a minimum of interference from weeds. Those weeds that

did grow were removed by hand usually by a weed patrol of two workmen much as "spot weeding" is done during the growing season in some nurseries today.

Today soil treatment is a professional job for custom applicators and much in demand in horticulture. Care and calibration of equipment for injection purposes are critical matters. Laying plastic and applying asphalt emulsions are also critical but results can be spectacular from low rates of weed killer operating under conditions for maximum effectiveness on germination and early growth of weed seedlings i.e. through ample moisture, uniform temperature and with prolonged herbicide effect.

The Howard hoe and other rototillage equipment was new in 1940's and has changed control in weedy nurseries. The budding-in-row weeder was later developed to weed carrots but does an excellent job of weeding and hilling nursery liners and even larger stock in weed free sandy soils. Last year this conference was introduced by Mr. Asper K. Laursen to weed control using compressed air. The machine has been used for six years in Canada and longer in Europe. More new practical equipment is welcome as an alternative to the use of chemicals. Present advances in mechanical harvesting will likely provide new efficient equipment.

Keep the dosage level within those listed on the label and be sure that spray equipment is tested by trial runs with water to see that nozzles operate properly and to determine the volume of spray discharged per acre and thus avoid over dosage and irregular spray patterns of herbicides. Spray equipment needs thorough cleaning and calibrating. The use of wetting agents and similar additives should be confined to cases in which they are actually specified. Directions for application should be checked and trial runs made before application takes place.

It has been estimated that 100 million acres of the earths surface are treated each year with herbicides in the production of food and fibre crops so that present concern about pesticides is not without some justification, hence selection of herbicides for nurseries should be limited to those whose fate or breakdown is known.

Nursery Weeds

Only a few weeds make up "Nursery Weeds". A survey was conducted by correspondence with nurserymen several years ago and repeated last winter with few changes. The weed list includes 19 perennial weeds, 7 winter annuals and 16 summer annuals. The American Weed Society lists some 2700 weeds.

Perennial weeds of nurseries include quackgrass and mugwort or Artemisia also thistles and bindweeds sowthistle and nutsedge. These weeds have stolons or other forms of underground stems which respond to a limited group of herbi-

cides through abnormal cell division and death of translocation and storage tissue.

Since plot margins tend to remain clear cut between treated and untreated areas the movement of these herbicides within stolon tissue is probably quite limited in comparison to movement of herbicides and other solutes downward through the soil itself except for absorption in soils of loamy nature or where suitable absorbing agents such as activated charcoal are introduced.

Pure stands of mugwort (Artemisia) or of quackgrass can be dealt with in regular crop rotation without using herbicides but this is a question of time and cost which the nurseryman has to decide for himself. In any case thoroughness and persistance are necessary to achieve good control.

Winter annuals — germinate in autumn and include mayweed or stinkweed, mustard and yellow rocket, annual bluegrass and chickweed. They all germinate in October and attain some true leaves before winter. Simazine spray or granular 5 pounds active ingredient or less is effective according to soil type but at a higher dosage rate than for seedling summer weeds. Dichlobenil, Diuron and other herbicides are also effective in granular or spray form. Crops are dormant and seldom injured, unless flooded or iced over for prolonged periods after the herbicide is applied, thus November treatment is perferred.

Presence of herbicides in moist soil facilitates the entry of these chemicals into seeds and etiolated stems so that growth patterns are modified in translocation tissue and food reserves used up before normal foliage developes to support growth. Normal true roots of woody plants appear to grow in herbicide treated soils without injury from treatments made on the soil surface. The extent and depth of the root system is important in survival. Dipping liner roots or root ball in activated carbon slurry or incorporating activated charcoal in the plant row before planting may help early growth by avoiding herbicide effects, however proper fertilization and irrigation are important for early vigorous growth.

Summer Annual Weeds

Summer annual weeds begin to germinate in late May. Crabgrass appears shortly after a three to five day period of weather in the 70's. Redroot-pigweed. lambs quarters, ragweed, and annual grasses follow quickly. Purslane is a nuisance since it will root from cuttings produced by hoeing. Summer annual weeds are best stopped at the time of planting liners and other nursery stock in spring. Complete the planting by irrigation and later after soil is workable but before weeds emerge, use herbicides and incorporate lightly, if this is called for, otherwise surface application is usually enough particularly if the crop is irrigated periodically.

An extensive research project on summer weed control is reported in the 1966 Plant Propagators Proceedings by Arthur S. Myhre at Western Washington Research and Extension Center at Puyallup. Rooted cuttings from propagating frames were lined out in the spring in nursery rows; a month later the soil was hoed so it is weed free. Weed seeds were then sown uniformily to insure adequate and uniform infestation. Herbicides were applied by a machine *properly equipped to provide good agitation of spray materials, accurate calibration and adequate and uniform coverage over crop and soil surface* except were incorporation of the herbicide was a required part of application procedure. The word incorporate is vague but usually means "mix into the soil surface to something less than an inch in depth" or to slightly above the depth to which seeds are planted or roots are placed. Myhre indicates that after herbicide application if rain was not imminent then irrigation was given. Otherwise some herbicides tend to volatilize from or become inactive on a warm dry surface, then the possibility of effective weed control is lost. Myhre repeated his tests for four years then removed the plants, rototilled the former plant row and sowed a test plant (oat) to evaluate any residual herbicide effect. No effect was found, and at Ithaca, New York with a similar 5 year period of repeated application no clear cut response was noted with oats. Present plots to which granular Neburon was applied for five years still show *reduced weed growth* and on sandy soil at Ithaca there is some indication of reduced weed growth following five years of Simazine and of Amizine at 5 pounds active ingredient levels.

Myhre tested sixty herbicides and of these Simazine, Casoron and Herban were outstanding. Simazine 80 W was tested for nine years and gave good all summer control of annual weeds at 2 pounds and 4 pounds per acre. Three azalea varieties and boxweed showed discoloration but many evergreens did not.

Myhre used the trade formulation Casoron 50W at rates of 8 to 12 pounds ie. the active ingredient Dichlobenil at 4 to 6 pounds. The tests continued for five years, with the comment "It has a fairly long residual life and has given good to excellent control of summer annual weeds at rates ranging from 8 to 12 pounds (Casoron)". No plant injury was observed in azaleas, rhododendrons, Pieris, Viburnum, Osmanthus, and Ilex crenata.

Herban 80W was also tested and gave good weed control under mild moist climatic conditions. Treflan was tested in 1965 only, so too, were combinations of Paraquat, a contact herbicide of note and used with Simazine and with Casoron and applied as a directed spray i.e. beside but not over crop plants.

The cool moist climate of Western Washington is duplicated in the Northeast during October or November but decid-

ous nursery crops are approaching dormancy and are less likely to be injured by herbicides. Seeds of winter annuals are at germination stage and easily injured so that weed control in the plant row is a real possibility with the choice of bare soil or a crop cover — oats or weeds between the rows for winter protection and snow holding value.

READ AND USE LABEL INFORMATION

Label information indicates the purpose for which the product is intended, example Simazine 80W is for pre-emergence weed control on certain agricultural crops and specifies nurseries, Christmas tree planting and shelter belts.

Directions include — for those plants listed below and which have been transplanted for a year or more use 2½-3¾ pounds of Simazine 80W in at least 25 gallons of water per acre (of acre actually sprayed) in the fall or spring prior to weed emergence. Thirty-four species are listed on the label. A cautionary note is included in the box:

(a). Do not use Simazine 80W in seedling or cutting beds.
(b). Transplants for Christmas Tree and shelter belts should be 3 years of age.
(c). Do not apply 80W more than once a year.
(d). The lower rate is for sandy soil.

The Simazine 80W label also carries a caution. Keep out of reach of children. Harmful if swallowed. Avoid contaminating feed and food stuff. Avoid inhalation.

Beyond the cautions on the label is the matter of applying herbicides so that their coverage is uniform and at a predetermined rate and pattern usually so that the herbicide is directioned from the side to cover the soil band in which the crop is growing but without any greater contact with nursery stock than is necessary. Fall treatment is less critical since woody plants are dormat and hopefully only seedling weeds are present. Granular formuations can usually be handled in modified fertilizer spreaders or others of cyclone type.

These statements seem to make weed control with air as illustrated by Asper K. Laursen of Bowmanville, Canada to be an idea method with few difficulties.

Conclusion

Use sterile media for seed and cutting beds.

Use clean lining out areas free of perennial weeds. After plants are thoroughly watered and conditions for continued growth assured then use mechanical forms of weed control, otherwise low rates of Simazine or an other herbicide widely used in weed control in vegetable crops in your area.

In November and after cultivating or use of Budding-in-row weeder use minimum rates of herbicides applied earlier.

In early spring while plants are still dormant or near

bud break use a contact herbicide such as Paraquat or cultivate. Hopefully no treatment is needed at this time but be on the alert for perennial weeds and for infestations of unsuspected annuals.

This is where a weed patrol system helps to keep one altered to needs before emergencies arise.

WEEDS OF NORTHEAST NURSERIES

1 Noted by nurserymen - 18
2 Noted by research workers - 11
3 Noted by Dept Agr Per - 45
N Noxious weed-Fed Seed Act

Names follow Jr W.S.A. Weeds, Vol.10, p. 255-274. 1962

A Annual
B Biennial
P Perennial
W Winter annual

1	2	3	N	P	Agropyron repens (L) Beauv	quackgrass
1	2	3	N	P	Allium canadense L.	wild onion
1	2	3	N	P	Allium vineale L.	wild garlic
1		3	A		Amaranthus retroflexus L	redroot pigweed
1	2		W		Anthemis cotula L	mayweed
1	2	3	P		Artemisia vulgaris L	mugwort
		3	N	A	Avena fatua L	wild oat
	2	3	W		Barbarea vulgaris R. Br	yellow rocket
	2	3	N	W	Brassica kaber (DC) Wheeler var pinnatifida (Stokes) L C Wheeler	wild mustard
		3	W		Capsella bursa-pastoris (L) Medic	shepherdspurse
1		3	P		Cerastium bulgatum L	mouseear chickweed
1	2	3	A		Chenopodium album L	common lambsquarters
1	2	3	N	P	Cirsium arvense (L) Scop	Canada thistle
1	2	3	N	P	Convovulus arvensis L	field bindweed
1	2	3	N	P	Convoluvulus sepium L	hedge bindweed
1	2	3	N	P	Cyperus esculentus L	yellow nutsedge
1	2	3	N	A	Digitaria ischaemum (Scherb) Muhl	smooth crabgrass
1	2	3	N	A	Digitaria sanguinalis (L) Scop	large crabgrass
1		3	A		Echinochloa crusgalli (L) Beauv	barnyardgrass
1	2	3	P		Equisetum arvense L	field horsetail
1			A		Erigeron canadensis L	horseweed
1	2	3	N	P	Euphorbia esula L	leafy spurge
	2	3	A		Galinsoga ciliata (Raf.) Blake	hairy galinsoga
1			N	P	Galium mollugo L	smooth bedstraw
1	2	3	P		Glechoma hederacea L	ground ivy
		3	N		Ipomoea sp.	morning-glory
1	2	3	W		Lactuca scariola L	prickly lettuce
1		3	A		Lamium amplexicaule L	henbit
1		3	N	W	Lepidium campestre (L) R. Br	field pepperweed
1		3	A		Oxalis stricta L	yellow woodsorrel
1	2	3	A		Panicum capillare L	witchgrass
1		3	N	P	Plantago lanceolata L	buckhorn plantain
1		3	N	P	Plantago rugelii Dene.	blackseed plantain
1		3	A		Poa annua L	annual bluegrass
1		3	A		Polygonum aviculare L	prostrate knotweed
1		3	A		Polygonum pensylvanicum L	Pennsylvania smartweed
1		3	A		Portulaca oleracea L	common purslane
1	2	3	P		Rhus radicans L	poison ivy
1	2	3	N	P	Rumex acetosella L	red sorrel
1	2	3	N	P	Rumex crispus L	curly dock
1		3	A		Setaria viridis (L) Beauv	green foxtail
1	2	3	N	P	Solanum carolinense L	Carolina horsenettle
1	2	3	N	P	Sonchus arvensis L	perennial sowthistle
1		3	W		Stellaria media (L) Cyrill	common chickweed
1	2	3	P		Taraxacum officinale Weber	dandelion

ADDITIONAL NURSERY WEEDS
Transportable B & B, etc.

N	A	Abutilon theophrasti Medic	velvetleaf
P		Aegopodium podagaria L	goutweed
A		Amaranthus graecizans L	prostate pigweed
P		Ampelamus albidus (Nutt) Britt	climbing milkweed
P		Apocynum cannabinum L	Indian hemp
P		Asclepias syriaca L	common milkweed
N	W	Bromus tectorum L	downy brome
N	P	Cardaria draba (L) Desv	hoary cress
N	A	Cuscuta sp	dodder
N	P	Cynodon dactylon (L) Pers	Bermudagrass
N	B	Daucus carota L	wild carrot
P		Duchesnea indica (Andr) Focke	Indian strawberry
P		Helianthus tuberosus L	Jerusalem artichoke
P		Leontodon autumnalis L	fall hawkbit
P		Lonicera japonica Thunb	Japanese honeysuckle
P		Lysimachia nummularia L	moneywort
A		Matricaria matricarioides (Less) Porter	pineappleweed
P		Phytolacca americana L	pokeweed
P		Polygonum cuspidatum Sieb and Zucc	Japanese knotweed
P		Rosa multiflora Thunb	multiflora rose
N	P	Rubus fruticosa L	wild blackberry
N	P	Rumex altissimus Wood	pale dock
N	A	Setaria faberi Herrm	giant foxtail
A		Setaria glauca (L) Beauv	yellow foxtail
P		Sorghum halepense (L) - Pers	Johnsongrass
A		Spergula arvensis L	corn spurry
P		Striga asiatica (L) Kuntze	witchweed
N	W	Thaspi arvense L	field pennycress

WEED CONTROL IN NURSERY AND LANDSCAPE PLANTINGS - 1966

1. Important weeds in nursery and ornamental plantings.
   (a). Stoloniferous perennials —
   Agropyron repens — Quackgrass
   Artemisia vulgaris — Chrysanthemum weed
   Thistles, bindweed, etc.
   (b). Seedling annual weeds in new spring plantings.
   1. Spring
   Amaranthus retroflexus — Red Root
   Chenopodium album — Lambs- Quarters
   2. Summer
   Digitaria sanguinalis — Crabgrass
   Portulaca oleracea — Purslane
   3. Late summer (a). annuals
   Poa annua — Annual bluegrass
   Stellaria media — Annual chickweed
   4. Late summer (b). biennals
   Barbarea vulgaris — Yellow rocket
   Capsella bursa-pastoris — Shepherds purse
   Anthemis cotula — Mayweed

2. Common combinations of crop and weed populations in nursery and ornamental plantings.
   (a). Heavy stands of the perennial weeds, quackgrass and artemisia among 2 years and older woody nursery and landscape plantings.
   (b). Stands of perennial weeds in fall on land to be planted to young nursery or landscape plantings in spring.
   (c). The rapid appearance of seedling weeds, annuals, biennials or perennials, among new nursery and landscape plantings with new foliage and young shoot growth.
   (d). The rapid appearance of seedling weeds in fall among new or established nursery and landscape plantings at a time when buds, shoots and foliage is mature but seedling weeds are soft and active in growth at germination and first leaf stage.
   (e). Fall fertilizing may make seedling weeds more succulent but is taken up by woody ornamentals and stored for rapid new growth in early spring. Fall fertilizing and herbicide applications are compatible and can be orderly and efficient particularly with granular formulations.
   (f). Fall fertilizing and herbicide use can result in weed free soil through the spring sales or planting period. When new weeds appear cultural, mechanical or chemical treatments can be used as appropriate. Mulches used over herbicide treatments tend to prolong the period of weed control.

WEED CONTROL PROGRAMS

A. *Before planting and to free the soil of weeds by one or more procedures.*
   1. Crop rotation — fall plow, fit in spring.
   2. Plow or rototill for fall steam sterilization or fumigation.
   3. Combine herbicide with fall plowing for quackgrass and artemisia control. *Use one of the following*:
      (a). Use dichlobenil 10 lb. Aia. in fall, plow in spring.
      (b). Spray with amizine 5 lb. Aia. 10 days before plowing. If regrowth occurs respray with amizine 3 lb. Aia. 10 days before spring soil preparation.
      (c). Use EPTC 10 lb. Aia. in fall, plow and work to incorporate in loamy soils; residual action is longer in muck soil.

B. *Early spring planting of dormant liners in weed free soil.*
   1. Plant liners, add fertilizer and irrigate. Treat when the foliage is dry.
   2. When seedling weeds emerge, use granulars in the crop row as a band or use directional spray. Cultivate between rows

or use overall treatment for a month to 6 weeks of weed free growth. *Use one of the following*:

Herbicide	Rate lb Aia	Note
CIPC	4-6	4-6 WF*
DCPA	15	varies
Dichlobenil	2-4	4—8+ WF
Diphenamid	1-2	Incorporate, 4—6 WF
Diuron	1-2	4—8+ WF
DNBP	4	cool day, 4 WF
EPTC	3-5	Incorporate, 4 WF
PCP	10	4—8 WF
Simazine	2	4—8 weak on crabgrasses, etc.
Trifluralin	1-2	Incorporate, 4—8 WF

*WF - Weed Free period in weeks.

C. *Crop with mature basal foliage in summer; weeds less than one inch growing actively.* Use granulars on moist soil when crop foliage is dry or use directional basal spray (for summer annual weeds). Four to eight weeks control unless cultivated then new weed population is likely to develop.

Herbicide	Rate lb Aia.	Note
Amizine wettable powder	2-3	agitate
Dichlobenil	2-4	granular preferred Moist soil.
Diuron granular	1-2	Surface applied do not incorporate
DNBP	2-4	4-granular preferred
Paraquat	2-3	4-directional
PCP	10	6-8 granular preferred

D. *Fall seedling weeds after last cultivation in fall.* Ornamentals crops are mature or dormant; weed growth is young and active. Apply herbicides alone or with fertilizer at the rate of one ton per acre of 10-10-10; soil to remain weed free till June or later, i.e. 4-6 months or longer.

Herbicide	Rate lb. Aia.	Note
Amizine	3-5	directional
CIPC	5-10	granular
Dichlobenil	3-5	granular
Diuron	2	granular
DNBP	4-8	granular
PCP	15-20	granular
Simazine	5	granular

These are recommended for use among dormant woody ornamentals and for artemisia, quackgrass, etc. control in low growing evergreens used for ground covers. Use as

granulars. Woody weeds (maple, mulberry, seedlings, etc.) are not controlled.

E. *Special weeds in ornamental plantings.*

1. *Polygonum cuspidatum* — Japanese Bamboo. Tordon granular 1-2 lb. Aia. Fall. Avoid use near water sources for greenhouse or domestic supply. Banvel-D granular 2 lb. Aia.

2. *Rhus Toxicodendron* — Poison ivy. Amitrole 1-2 lb. Aia. Can be used in fall until foliage drops. Stems spread along soil surface under grass and other plants; repeated spraying needed for complete eradication. *Read directions and warnings. Granular formulations perferred.*

F. *Landscape and nursery maintenance.*

Quackgrass, *Agropyron repens, Artemisia vulgaris,* and other stoloniferous weeds are difficult to eliminate. Fall application of granular dichlobenil at the base of woody ornamentals will kill rhizomatous grasses and other rhizomatous herbaceous vegetation leaving a weed free zone that will stay free of new weeds until mid summer, or later unless cultivated. Use dichlobenil at 5-10 lb. Aia. preferably as a granular applied from a crank duster or shaker. Wettable powder can be sprayed on, use 8-12 lb. Aia. 100 gallon i.e. 1 lb. active in 50 quarts (12½ gallon), do not incorporate i.e. do not hoe in. Do not use on Vinca, Hedera, Euonymus, fir, or evergreen seedling — liners. Granular herbicides used on clean soil and covered by a mulch of peat or sawdust, etc. increase the effective weed control among woody ornamentals.

G. New Plantings.

Petunias in pots and other ornamentals in containers may be treated with a slurry of activated charcoal by dipping, dusting or spraying the root ball at the time of planting. The charcoal serves to absorb certain herbicides in the soil and prevent damage to the ornamentals.

After planting the careful use of dichlobenil, simazine, and likely other herbicides as granules among newly planted, charcoal treated, ornamentals will keep plantings weed free for 4-12 weeks and also free of residual herbicide action. The amounts of activated charcoal range from 50 to 100 lb. per acre. A slurry of 1 lb. to 4 gallons of water to 1 lb. in 16 gallons of water would be a likely range or 1 gram/32 cc to 1 gram/130 cc. Keep the slurry stirred or agitated for satisfactory coverage of surface roots on the root ball.

Before applying herbicides, etc:

1. Check application equipment by trial runs over a measured area and collect the amount of spray or granular discharge so that the actual amount can be compared to the recommended amount.

2. When applications are to be made manually measure out the quantities of herbicide for the proper mix and apply the correct volume of herbicide to a limited area for trial and practice purposes i.e. 100 sq. ft. or 1000 sq. ft. Make at least 3 trial runs before field application. Check for uniform coverage, at least by inspection and better by measuring the volume or weight of several samples collected from 3′ x 3′, or 5′ x 5′. The more uniform the samples are the more likely that uniform results will follow. Danger of local over dosage is thus diminished and a familiarity with the appearance of correct distribution is gained before extensive applications are made.
3. Avoid over dosage and skips — over dosage damages or/and kills plants. Inadequate dosage is a waste of time and effort.
4. Reread and recheck recommendations for preparation, use and disposal of herbicides and containers. Give due regard to possible contamination of domestic and greenhouse water sources.

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MODERATOR COGGESHALL: Thank you very much, Dr. Pridham. Our next speaker in this afternoon's symposium is no stranger to our Society. I am very happy to introduce Mr. William Flemer.

HERBICIDES — Nursery Tool, Not Panacea

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Not so many years ago, the program chairman of a nursery meeting who wanted to give a glimpse of the future would cast about for a speaker who knew anything about herbicides. After a long search, if he was lucky he would locate a college professor or extension specialist who had put out some test plots and could make some tentative recommendations, well hedged with the advice to go slowly. Now most nurseries use herbicides as a matter of routine, and each one has its favorites as well as some special combinations which particularly suit that soil and climate. Experiment stations have files full