

**HAZELNUT PRODUCTION MANUAL:
Better Management for Higher Yields
and Increased Profits**





A step-by-step guide broken down into sections that aims to aid hazelnut production from bottom to top

PLANTING

- Which varieties should one use?
 - Anakliuri has round nuts, Dedoplistiti has long nuts, and are the best cultivars native to Georgia.
 - The following lists depict recommended varieties for Georgia:

Cultivars Recommended for Trials:

Barcelona (in-shell)
 Ennis (in-shell, Eastern filbert blight susceptible)
 Lewis
 Clark
 Sacajawea (OSU 540.130)
 Santiam (OSU 509.064)
 Yamhill (OSU 542.102)
 Jefferson (OSU 703.007)
 Casina (Eastern filbert blight susceptible)
 Negret
 Pautet
 Segorbe
 Mortarella
 San Giovanni (long, in-shell)
 Tonda di Giffoni
 Tonda Gentile Romana
 Tonda Gentile delle Langhe
 Corabel (in-shell)
 Ata Baba (from Azerbaijan, good kernel quality)

Pollinizers Recommended for Trials:

Butler

Hall's Giant
 Gamma
 Delta
 Epsilon
 Zeta
 Eta (OSU 984.075)
 Theta (OSU 1001.008)

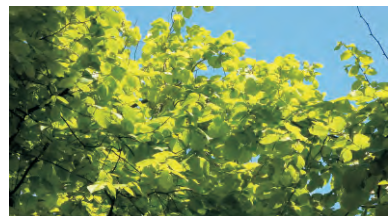
Clonal Rootstocks:

Dundee
 Newberg

Useful for Breeding:

Belle di Giubilino
 Cherkesskii II (important in southern Russia, long nuts)
 Ghirara (from Sicily)
 Ianussa Racinante (from Sicily)
 Montebello (Nocchione) (from Sicily)
 Nocchiolino Sangrato (from Italy)
 Ribet (from Spain, male-sterile)
 Romische Nuss (from Europe)
 Rote Zellernuss (red leaves, from Germany)
 Turkish selections





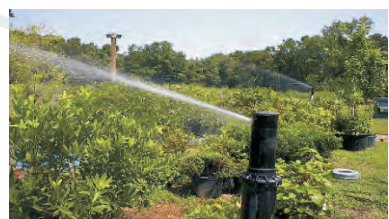
CULTIVATION

- Start cultivation immediately after soil is dry enough
- Cultivate 15-20 cm deep enough to break up hard pan soil layers
- Prepare soil early so that moisture isn't lost
- Roll orchard floor firmly prior to harvest or use a flail mower
- Wider spacing might be needed with a vigorous cultivar



SOIL TYPE

- Well-drained soil is best; ensure the soil is at least 152 cm deep; the deeper, the better
- Orchards should not be located where soil is poorly drained, shallow, too heavy or too light
- Roots are found in the 1st meter of soil, but soils must be deep enough to allow active root systems to penetrate 2-3 meters
- Hazelnut trees draw moisture from upper and lower soil layers



IRRIGATION

It is necessary to irrigate often in the summer (especially July and August) since upper soil layers dry quicker than deeper soil layers. Drip irrigation may be optimal while trees are young.



POLLINATION

- Hazelnut trees are wind-pollinated, so wind direction and velocity are important during pollination period
- Beware! Major nut producing cultivars are self-incompatible!



ORCHARD FLOOR MGMT

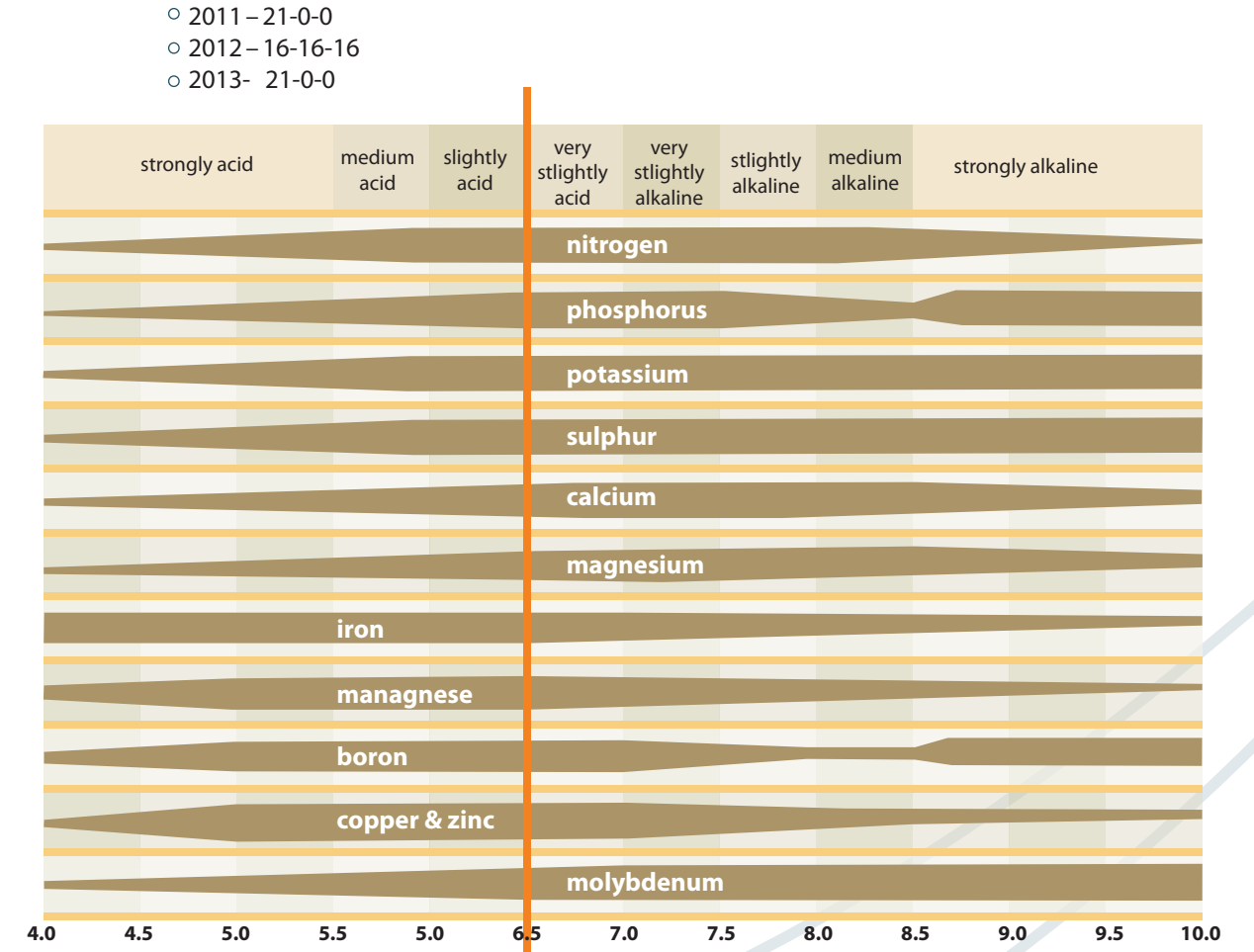
- Flail mowers are used to chop vegetation down to ground level, and also helps mulch leaves & blanks and eliminate old nuts on the orchard's ground cover
 - When to flail?
 - Flail 30 days prior to harvest, to smooth the orchard floor and to eliminate blanks
 - After harvest and about 4-6 times per season depending upon growth of ground cover
 - What to use when flailing?
 - Use 40 hp tractor & 2.5-2.75 meter-wide flail
 - Tips:
 - Only flail growth to within 0.6 cm of soil to minimize competition for moisture
 - Remove vegetation; the less vegetation, the less moisture usage by weeds and more moisture available to the trees
 - If you are using a cover crop and are planning to flail, plan to leave approximately 2.5 cm crop
- Herbicides
 - Alley-herbicides = Chemical mowing; helps to reduce the number of times the orchard floor is flailed
 - Use 360-480 grams/hectare of glyphosate + 2 kg of ammonium sulfate per 100 liters of spray solution

- Combining flails and herbicides
 - It might be useful to combine both actions because it will reduce amount of required herbicides
 - If herbicides are added in the tree rows, flailing is only needed in the alleys between the tree rows
 - Beware! Flailing can increase certain weed growth such as dandelions. To mitigate, use broadleaf herbicides such as 2, 4-D!
- Weed Removal
 - As an alternative to herbicidal control of weeds, the use of mulch is an option. Not only would it suppress weed growth, but it would also serve to retain more moisture in the soil. Materials to use for mulch might include sawdust, straw, manure, and other materials
 - Note that mulch needs to be flailed. Remaining mulch will slow or prohibit mechanical nut harvest
 - To reduce the weeds during the growing season, glufosinate or glyphosate are recommended
 - Extreme care should be taken during the application of glyphosate as contact with the leaves, and even young stems, of the hazelnut trees can be very injurious to the tree
 - Painting the young tree bark with white latex paint or using a plastic or metal trunk cover is helpful
 - Glufosinate and paraquat, when applied at sucker level, can be used to control the suckers as well as weeds



FERTILIZING

- Most trees need to have around 32- 40 cm of new growth so there is plenty of new wood for the nuts to grow. Nuts grow in the branches that grew the year before. The more growth, the more continuous nut production there is
- How much?
 - In August, test the leaves from mid-shoot if possible to figure out the amount necessary
 - Test soils anytime of the year when the ground is firm
 - Suggested applications (N-P-K): Each hectare needs approximately 200 pounds of Nitrogen. Urea is 46-0-0



- Which fertilizers to use?
 - Nitrogen (N)
 - 0.7-0.9 kg of N per tree broadcast
 - Apply N as urea in March or during bud-break
 - Younger trees beware! Younger trees need less and the N needs to be distributed evenly
 - If growing younger trees, apply N during 2nd year of growth (.06 kg per tree)

- Potassium (K)
 - 2.75 – 4.5 kgs of K₂O per tree
 - Only apply occasionally, as needed
- Boron (B)
 - 2.25 kg-3 kgs per hectare
 - Apply mid-May to early June
 - Foliar spray at rate of 1 kg per hectare
 - Apply as a broadcast
 - Beware! Do not use on trees younger than 5 years old!
 - If leaf testing shows a B reading is over 200 ppm, do NOT spray
- Lime - Lime soil to increase pH and to make N, K & Mg more available to the trees
 - Appropriate pH is 6.5



PRUNING

- Why prune?
 - Production needs new wood, and there is no other way to get this wood except to prune
 - **Important: Pruning is a method to attain higher yields as limbs grow**
It is important to have limbs grow 32-40 cm in order for yields to increase!
 - There is less limb breakage from ice and snow
 - Increase vigor, shape the tree, and increase light penetration
 - The correct way to prune is to remove 1/3 of the fruiting area from 1/5 of the trees annually
 - Prune each tree every 5 years

Recommended Pruning Equipment

- Hand pruners (Felco or ARS type, bypass, not anvil type)
- Long-handled loppers, 45 cm (Corona type, bypass, not anvil type)
- Hand-saw, 30-40 cm; bottle of rubbing alcohol or 10:1 diluted bleach for equipment disinfection
- Whetting stone/sharpener; oil and sharpening file

- **Safe** ladder (3-legged are best for uneven ground)
- Pole pruner, 3 meter (optional)
- Chain saw (optional)

Tree Pruning Priorities

1. Maintain health of tree:
 - a. Remove all dead, dying and diseased limbs
 - b. Remove crossovers, which can rub together and damage limbs and harbor disease
 - c. Remove hazardous branches before they fall
 - d. Correct and repair damage
2. Raise the canopy to increase pedestrian, vehicular or visual zone
3. Rejuvenate the tree by removal of old wood in such a way that encourages the formation of new wood (remove no more than 1/3 of the wood in one year)
4. Improve the aesthetic quality of the tree and thus its value
5. Slow the tree's growth by timely removal of foliage
6. Trees:
 - a. Increase nut production
 - b. Develop strong 45 degree angles to support nuts
 - c. Remove limbs that grow down or straight up
 - d. Maintain tree size
 - e. Maintain fruit spurs

When to Prune Trees

The best time to prune trees is generally during the dormant period, usually in late winter (November–March). However pruning can be done year-round, as needed; for example, dead or diseased branches can be removed any time, the sooner the better. When pruning trees, keep this in mind: Pruning done during the dormant season tends to have an invigorating effect on tree growth. Pruning done during peak growth times tends to slow growth by removing leaves that manufacture nourishment, but too much summer pruning can damage a tree. Pruning during the spring (post-dormancy) and fall (pre-dormancy) is generally the least desirable time as the plant is most vulnerable during those times.

Sooner rather than later: When you cut away part of a plant, a wound is left, susceptible to pests and diseases. To avoid trouble always prune so as to make small wounds, rather than large ones. Removing a bud or twig produces a smaller wound than waiting until it is a large limb! Rubbing off a sucker bud leaves a smaller wound than if you wait until it has a year's growth or more!



SUCKER CONTROL

- What are they?
 - Suckers are shoots sent up from the base of the tree. They need to be controlled because they oftentimes overwhelm the cultivar
 - The base of the trees has 4-8 stalks. On average, try to leave 4-6, if more are left, the nuts will get caught in crotch area and not be harvested
- What to do if they are seen?
 - If suckers get to be 15.25 - 23 cm tall, spray them with 2, 4-D amine or Gramoxone (be extremely careful with Gramoxone!) sprayed to wet foliage
 - Mix 1 liter of Gramoxone with 400 liters of water before spraying
 - Most growers spray 3-4 times per year
 - For best results, spray in cloudy weather or in the evening time when there is no sunshine
 - Failure to spray the suckers at appropriate times may require growers to cut the suckers out



PEST MANAGEMENT

A flock of chickens, approximately 20, can do an amazing job of keeping insects under control. They would probably need caging at night.

- Various pests and what to do about them:
 - Information about Weevils (Scientific Name: *Balaninus Nucum*)
 - Beetle lays eggs in small, tender nuts
 - Egg hatches 8-10 days afterwards

- Maggots are white, footless, fleshy and have a brown head and pupate in soil
- Spray them in May with arsenate of lead
- Winter cultivation of soil beneath bushes can destroy many
- Information about Hazelnut Longhorned Beetle/Twig Borer (Scientific Name: *Oberea Linearis*)
 - Colored black with yellow legs; Long and narrow body
 - Adults appear in the spring
 - Females lay eggs under twigs
 - To control, place white sheet on the ground, hit branches with a stick, and count the insects on the sheet. Monitoring adults between May and August, with presence most likely in June and July. Once the adult flight period has been identified, chemicals can be applied
- Information about Leaf-tier Moths (Scientific Name: *Machimia Tentoriferella*)
 - Eggs overwinter and hatch in April and May
 - Larvae feed on developing buds
 - If larvae are already seen, hard to prevent
 - The preventative treatment is to be applied 1st week of May is rotenone
 - Insecticides that are applied when larvae are very small will lower the next generation
- Information about Winter Moths (Scientific Name: *Operophtera Brumata*)
 - Colored light green when in larvae stage, and they eat buds and leaves
 - If these moths are seen, the most that can be done is to treat for next year's moths with chemical, Lorsban
- Information about Leaf Roller Caterpillars (Scientific Name: *Calpodex Ethlius*)
 - Spraying must start late April or early May since these pests can decrease yields
 - Important to note that Leaf Roller Caterpillars only have one generation per year, so there is usually no need to spray after tree has been defoliated
 - Some growers spray once every 3 years to control leafroller population
 - Spray when there is 20-25% infestation
 - Spray includes Bt for large infestations and Spinosad (organic chemical) for lesser populations of Leaf Rollers
- Information about Oblique-banded Leaf Roller Caterpillars (Scientific Name: *Choristoneura Rosaceana*)
 - These pests are two-generations per year
 - The first flights takes place mid-June and are the most damaging
 - The second flights take place in September
 - Lay out pheromone traps to determine the quantity of moths
 - If 40 moths are caught in the traps per week, insecticide spraying of Bt is necessary
- Information about Fall Webworm (Scientific Name: *Hyphantria Cunea*)
 - Black-headed insects found in Western parts of Georgia

- Identifiable by their eggs: yellow, clustered or their larvae: brown-gray late May-late October
- The most effective control is bacterium Bt when larvae are small
- Information about Bud Mites (*Scientific Name: Phytocoptella Avellanae*)
 - Bud mites are identifiable by their white, small, cigar-shaped bodies
 - They overwinter in enlarged buds, so it is best to inspect dissected buds to see how far along they have progressed in their quantity
 - Sampling should take place in March or April
 - Place tanglefoot material on twigs surrounding the blasted buds to identify quantity
 - Apply chemical Envidor once between March 20-April 20th when shoots have 3 leaves
- Information about Aphids (*Scientific Name: Corylobium Avellanae*)
 - Chose 3 terminals per tree and count aphids on the newest fully expanded leaf on each terminal
 - Aphids are small, soft-bodied, pear-shaped insects usually found on the underside of the leaves
 - Start sampling in April. Count same time each month in April, May, June and July. If 20, 20, 40, 40 aphids are counted respectively, the threshold has been reached
 - If threshold is reached, spray Acetamiprid, but not more than 4 times per season
 - Beware! Occasionally aphid mummies will be found – do not spray if found. These are the filbert parasite predators combating the aphids
 - If able, grow wild areas with flowering plants; this will help predator populations increase



BLIGHT MANAGEMENT

- Blight is rapid discoloration and wilting of plant tissues; death of plant tissue
- Blight can be spread from tree to tree on pruning shears
- Disinfect pruning shears with bleach or 70% rubbing alcohol before using shears on next tree
 - Common Bacterial Blight – Identification & What to do
 - Seen mostly in young trees up to 6 years old
 - Copper spray September and March since the harvest typically ends around August 20, but

- do so before rains fall
- Leaf scars are a main entry point, so it is important to apply the copper prior to leaf fall.
- The spray reduces the bacterial population
- Drip irrigation will also reduce bacterial blight
- Eastern Filbert Blight – Identification
 - Disease is characterized by small ball shaped pustules that line up vertically on infected branches
 - Spores are spread within and in between trees via wind and rain
 - There is a latent period of 12-15 months with no detectable symptoms
 - Check closely during late summer and winter to detect if trees are infected
 - If branches during this time period have dead leaves attached, infection may have already taken place
- Eastern Filbert Blight – What to do
 - If symptoms are detected, prune branch .3-.9 meters from spot of infection
 - Fungicide sprays should be applied at bud break in the spring (March, April, early May or when spores are active) and then every 10-14 days thereafter



SUN SCALDING

- Occurs when tops of trees are not grown enough to shade the trunk
 - Particularly affects younger trees
 - Use white tree paint to deflect light until trees are approximately 3-4 years old
If paint is used, be sure to paint the soil line too



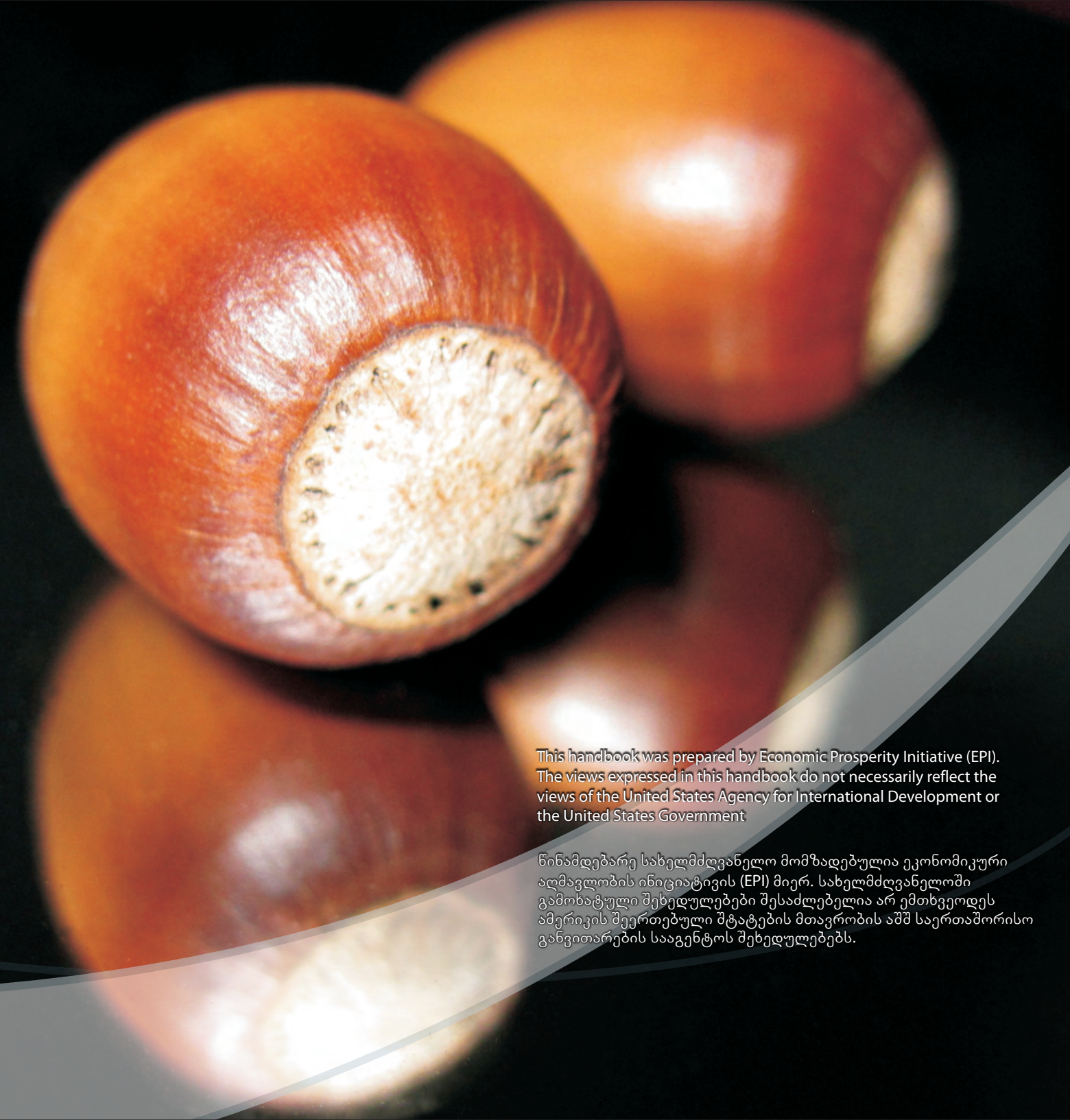
MOSS & LICHEN

- Moss usually grows due to shading and lack of pruning
- Growth on tree trunks that can increase breakage of limbs
- Copper and lime sulfur sprays reduce the amount of moss on the trees
- Treatment can be applied early winter or early March
- Once the moss and lichen are killed, they will slough off the tree on their own



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