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SUMMARY – Norms are drawn up to be followed in crop husbandry, type of plant material, fertilization, irrigation, cultivation techniques and in particular phytosanitary protection. Norms include methods for monitoring pests and their evolution, techniques for pest control, authorized pesticides, consideration of toxicity for users as well as repercussion on the beneficiary fauna and residues.

Key words: Pomegranate, production, integrated, normative.

RESUME – *"Projet de normes techniques pour une production intégrée du grenadier à Valence". Des normes sont définies pour application en conduite des cultures, type de matériel végétal, fertilisation, irrigation, techniques culturales et en particulier protection phytosanitaire. Les normes comprennent des méthodes pour le suivi des ravageurs et leur évolution, des techniques pour la lutte contre les ravageurs, les pesticides autorisés, la prise en compte de la toxicité pour les utilisateurs ainsi que les répercussions sur la faune bénéfique, et les résidus.*

Mots-clés : *Grenade, production, intégrée, normes.*

Definition and objectives of integrated production

Integrated production (IP) is defined as high quality economical fruit production, where priority is given to the safest pest control methods, minimizing the undesirable effects of agrochemical products, better safeguarding both the environment and human health.

The following objectives are proposed: (i) to encourage environmentally friendly culture that is economically viable and that maintains the multiple functions of agriculture and its social, cultural and recreational aspects; (ii) to ensure a sustainable production of health and high quality fruit with a minimum of pesticide residues; (iii) to protect farmers when handling agrochemicals; (iv) to promote and maintain the diversity of orchards and neighbouring areas; (v) to give priority to the natural regulatory mechanisms; (vi) to conserve and enhance soil fertility; and (vii) to minimise contamination of water, soil and air.

Legal background

The Valencian Government Decree 121/1995, of 19 June, points out "the basic guidelines of Integrated Production, such as: (i) its purpose; (ii) definition of IP; (iii) scope of application; (iv) labelling; (v) coordinating commission, composition and functions; (vi) production norms; (vii) use of brand or logotype; (viii) obligations of farmers; (ix) control and certification bodies; and (x) sanctions".

The Order of 23 May 1997, of the Council of Agriculture Fisheries and Food, developed the Decree 121/1995. Article 2 stipulates that the regulations for each crop will be established by the General Resolution of Research, Technological Development and Plant Health, fixing the minimum contents: (i) type of plant material; (ii) fertilization, maximum applicable quantities; (iii) irrigation, if appropriate; (iv) crop techniques, pruning, soil and weed management; (v) phytosanitary protection, with indication of follow-up measures and evaluation of different pests and diseases, appropriate control techniques and authorized pesticides in each case; (vi) harvesting conditions and possible post-harvest treatments; and (vii) notes and records to be kept in the field book or farm records.

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The contents that should figure in the crop husbandry regulations are described in Table 1, distinguishing between strict normative rules or prohibition and recommendation.

Table 1. Crop husbandry regulations

Practice	Strict normative rules or prohibition	Recommendation
Soil characteristics	Minimum soil depth of 50 cm for roots.	Recommended percentage of active lime 12-15%. Appropriate pH between 7-7.5. Recommendable texture loam or loam-clay. Conductivity of the soil (dry extract) no higher than 3.5 mmhos/cm.
Soil preparation and planting	Left-over roots eliminated to a maximum when planting out. Trenching without turning up soil. Physico-chemical analysis of soil before planting in new plantations. Chemical disinfection of land is not permitted. 5 years must elapse after disinfection before registering a chemically disinfected plantation. Plantation layout to leave minimum space of 1.50 m between rows of trees to facilitate work and favour light conditions.	Nematological analysis of soil. Organic fertilizer between 25-40 MT/ha. Base dressing in accordance with previous analyses. Trenching no deeper than 60 cm. Terrace slopes in flood irrigation should not exceed 2/1000 and in spot irrigation 10/1000. Advisable layout 5×3 m. A four-year fallow period is advisable before replanting.
Plant material	Use of certified material in new plantations. If not possible, use best quality rootstocks and varieties possible. Tables 2 and 3.	
Irrigation	Maximum annual volume below 7,000 m^3/ha/year in flood irrigation and 6,000 m^3/ha/year in spot irrigation. Water analysis every 3 years.	Water with a conductivity over 4 mmhos/cm, with a SAR ratio over 18 or a chloride ion concentration over 0.7 g/l is not recommended. Water with a boron concentration over 0.75 mg/l is not recommended.

Table 1 (cont.). Crop husbandry regulations

Practice	Strict normative rules or prohibition	Recommendation
Fertilisation	Obligatory soil analysis every 5 years. Obligatory leaf analysis every 3 years. Analyses to be attached to the farm notebook, clearly reflecting plantation site. Plots to be analysed during the first year of registration. The following limits should not be exceeded: 106 FU nitrogen, 84 phosphorus, 234 potash and 25 magnesium, in flood irrigation. In drip irrigation, 85 nitrogen, 67 phosphorus, 187 potash and 20 magnesium. Of total nitrogen requirements, deduct amount supplied by organic matter and/or nitrates of waters used in irrigation. In flood irrigation, nitrogen fertilizer should be fractioned between bud bursting of buds and fruit thinning in irrigation events. In drip irrigation, this fractioning will be carried out monthly in the following percentages: March, 5%; April, 25; May, 25; June, 20; July, 15 and August, 10%. Content of organic matter in the soil should be over 1%. Contamination by fertilizers should be avoided, especially by nitrates. Organic and mineral fertilization should have a low heavy metal and toxic content corresponding to the requirements stipulated in Table 4.	Leaf fertilisation should only be used when states of deficiency are detected, either through symptoms or as a result of the soil and/or leaf analyses.
Use of plant regulators	Plant regulators are prohibited. Fruit will be thinned leaving one fruit per bud.	
Soil management	Tillage soil conservation. Spontaneous plant cover compulsory from mid autumn to end of winter. Herbicide use restricted to the following situations (Table 5): - Rows under drip irrigation. - Tree drip areas. - Patches of problematic weeds.	
Pest and disease control	Priority will be given to biological and crop pest and disease control over chemical treatment. Ecological options: - Release of *Cryptolaemus* for control of *Planoccocus citri*. - Elimination of mummified fruits during pruning for control against *Cryptoblabes*. Treatments applied respecting criteria established for each pest and disease, applying thresholds when established. Systematic treatments prohibited. Scheduled treatments without previous justification prohibited. Phytosanitary products will be selected taking into account their toxicity for beneficial fauna, residues, contamination of soil and water, selectivity, phytotoxicity hazard and efficacy. Phytosanitary products highlighted as recommended (R) or tolerated (T). Maximum application levels to be fixed each year with certain active matter. Content of pesticide residues in the final product to be less than 50% of maximum residue limit (MRL). In the case of fruit destined for export, the mentioned normative for the destination country should be fulfilled, if known. Products not specified in these norms are prohibited.	For the adequate monitoring of different pests and diseases, the sampling criteria established in Table 6 is recommended. The alternation of active matter in order to avoid problems of resistance. Recommended products indicated (R) and tolerated products (T).

Table 1 (cont.). Crop husbandry regulations

Practice	Strict normative rules or prohibition	Recommendation
Machinery	The machinery used in the application of phytosanitary products and herbicides should be kept in proper working order in order to obtain maximum efficacy and decrease contaminating effects. Appropriate devices such as screens should be used to avoid drifting problems.	Three-yearly revision for treatment equipment recommended.
Harvest and conservation of fruit in storage	Harvest in appropriate season for each variety, seeking maximum quality in appearance and in colour, as well as consistency of the pulp and the optimum degree of acidity/sugars. Harvested fruit will not be exposed to sunlight. Fruit destined for cold storage should be subjected to a selection process that eliminates the fruit affected by any pest, disease or physiopathy.	
Environmental protection	Necessary measures to protect the flora and fauna of nearby areas to be taken. Precautions of this type to be stated in the farm book. Surplus phytosanitary products and liquids for cleaning treatment machinery not to be disposed of in the irrigation ditches, channel waters, rivers, wells, etc. Packaging, containers and recipients of agricultural products not to be left in or near the plot. They will be collected and disposed of in the appropriate manner for waste products. At least 5% of the farm, or location, must be managed as a "zone for ecological compensation" with minimum use of pesticides and fertilizers, in order to improve the botanical and faunistic diversity. Plot borders, abandoned plots, non-cultivated areas can be included.	
Farm book	To belong to the association of IP, it is compulsory to participate in an introductory course and later attend regularly organized courses. Farmers joining the IP programme should have a farm book, complying with the model approved by the Council of Agriculture, Fisheries and Food. Sufficient detail will be given in the farm book of all tasks and incidents of the crop, and corresponding dates. This book should be updated weekly. The farmer, or technician responsible for the integrated production on the farm, will, through his signature, be responsible for the truth of the operations written down in the book. This book will always be available for inspection by the Certification and Control body of the corresponding IP control or by the official services. It may be requested for this purpose at any time and without previous notification. The farm book should be accompanied by the documentation accrediting the crop practices as well as the results of the required analyses. The certifying body will have free access to the integrated production plots in order to make the opportune checks.	

Table 2. Rootstocks to be used†

	Borde	Sweet
Resistance to root asphyxia	+++	+
Resistance to salinity	+++	++
Onset of production	+	+++
Vigour	+++	++
Tendency to produce suckers	+++	++

†+++ more favourable situation; ++ average situation; + mild situation.

Table 3. Varieties†

Characteristic	Variety		
	Valencian	Mollar	Israeli
Earliness	++	+	+++
Vigour	++	+++	++
Yield	++	+++	++
External colour	+++	++	
Internal colour	++	+++	
Fruit size	++	+++	++
Resistance to sun damage	+++	++	
Thickness of rind	++	+++	
Resistance to cracking	+++	+	
Woody part of seed	+++	+	

†+++ favourable; ++ average; + scarce.

Table 4. Maximum applications and concentrations of heavy metals permitted in soils

Element	Application (kg/ha/year)	Concentration (mg/kg)
Cadmium	0.15	3
Mercury	0.1	1.5
Lead	15	150
Nickel	3	75
Zinc	30	300
Copper	12	140

Table 5. Herbicides for use in pomegranates

	Mode of action†			Conditions of use
	Residual	Contact	Transloc.	
Paraquat+diquat		3		Post-emergence
Glyphosate		1	3	Plantation + 3 years post-emergence
Glyphosate+MCPA	1	1	3	Plantation + 3 years post-emergence
Glyphosinate		3		Plantation + 3 years post-emergence
Sulphosate		1	3	Plantation + 3 years post-emergence

†1 weak; 2 strong; 3 very strong.

Table 6. Pest and disease control†

Pest	Monitoring methodology	Intervention criteria: thresholds	Chemical control: a.m.	Biological control and beneficial fauna	Cropping methods
Aphids *Aphis punicae* *Aphis gossypii*	% shoots and/or occupied flowers	Before appearance of floral buds, 20-40% shoots occupied. After appearance of floral buds, 10-20% shoots/buds occupied.	Pirimicarb (R), pirimicarb+endosulfan (T), acephate (T)	*Scymnus* *Coccinella* *Chrysopa*	Application to specific spots. Suppression of regrowth and interior growth. No overuse of nitrogen fertilizer.
Planococcus ficus	Presence of cottony masses with living forms in cracks of the trunk. % of occupied fruits.	Bud bursting: presence. In vegetation: 5% fruit occupied.	Polysulphur Ca (R), summer oil (R), winter oil (R), oil+phosphorate (T), chlorpyrifos (T), methyl-pyrimiphos (T)	Release of *Cryptolaemus* 1 colony / 0.8356 m^2 (1 colony/25 adults) in July *Leucopis* *Chrysopa*	Thinning of fruit.
Borers *Cryptoblabes* *Myelois*	% fruit affected by oviposition and/or damaged.	5% fruits affected.	Chlorpyrifos (T), methyl-pyrimifes (T)		Fruit thinning. Maintain good vegetative state. Elimination of mummified fruit during pruning.
Wood borer *Zeuzera*	Control of adults with pheromones.				Eliminate branches with recent galleries. Avoid abandoned plantations.
Red mite *Tenuipalpus*	Observation in trunk cracks cease in vegetative growth. In vegetation % affected.	In bud bursting: presence. In vegetation: 5% affected fruits.	Mineral oil (R) at bud bursting, hexithiazok (R), fenbutestan (T)	*Fitoseidos* *Stethorus,* *Chilocorus*.	
Phytophthora	Observation neck of plant.	Presence of damage.	To the neck: copper composition. To the leaf: fosetil Al in spring.		Favour drainage. Not use hoe to suppress regrowth. Remove soil from neck zone.
Lorrya	In vegetation: % of affected fruit.	In vegetation: 5% of affected fruit.	Hexithiazok (R), fenbutestan (T)		

†R=recommended products, T=tolerated products.

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