 DOI: 10.19601/j.cnki.issn1943 - 9903.2017.06.018

Full Mechanized Production Technology for Double-Low Rapeseed in Xianning City

Shengwu XU[1*], An'an YU[1], Li ZHENG[1], Wenjuan XIA[1], Shisheng SHI[1], Xia WEI[2], Yunfei GONG[2], Xiaoping LIU[2]

1. Xianning Academy of Agricultural Sciences, Xianning 437000, China; 2. Agricultural Bureau of Xian'an District of Xianning City, Xianning 437000, China

Abstract This paper standardizes the operation of rapeseed production including variety choosing, field preparation, mechanical seeding, field management, mechanical harvesting *etc.*, to realize full mechanization of rapeseed production. The key technologies: the optimum sowing date was from mid-September to mid-October in rapeseed-rice (corn) double cropping system region, and from mid-October to late October in rapeseed-rice-rice triple-cropping region; seeding rate was 4.5 kg/ha - 6.0 kg/ha; the optimum density was 450000 - 750000 plants per ha; 150 - 240 kg N fertilizer, 60 - 90 kg P_2O_5 fertilizer, 90 - 135 kg K_2O fertilizer and 7.5 - 15 kg B fertilizer were used per ha, 50% of N fertilizer and the rest of fertilizer were used as basal fertilizer; segmented harvesting was done when 70% - 80% of siliques per plant was yellow and combined harvesting was done when more than 90% of siliques per plant was yellow or brown.

Key words Double-low rapeseed, Full mechanization, Production technology

1 Introduction

The winter rapeseed area in the Yangtze River valley is one of the main rapeseed producing areas in China, but the rapeseed production is mainly based on decentralized household management, the degree of mechanization is not high, and labor costs account for about 50 - 70%[1]. With the increase in production costs of rapeseed, the comparative benefit of rapeseed production has declined, and especially in 2015, the state abolished rapeseed acquisition and improved subsidy policy, leading to decline in rapeseed prices, thereby severely reducing farmers' enthusiasm for growing rapeseed and greatly reducing rapeseed production. In order to enhance the competitiveness of rapeseed industry, a set of cost-saving and efficiency-increasing production technologies are much needed to enhance rapeseed industrial development, and full mechanized rapeseed production is the key technology to reduce labor input, save production costs and improve planting efficiency[2-3]. During 2012 - 2015, under the support of early-maturing rapeseed variety breeding and full mechanized technical system in Hubei Province, after years of exploration and promotion by Xianning Academy of Agricultural Sciences, the full mechanized rapeseed production technology became increasingly mature, and the full mechanized production area of double-low rapeseed reached 26667 ha in Xianning City. However, this technology is not standardized and uniform enough in the process of rapeseed production. To better play advantages of full mechanized rapeseed production technology and enhance the competitiveness of rapeseed industry, this paper formulates the standardized full mechanized double-low rapeseed production technology in order to provide technical support for large-scale promotion of full mechanized rapeseed production.

Received: April 6, 2017 Accepted: June 10, 2017
* Corresponding author. E-mail: 541748162@qq.com

2 Variety selection

The double-low rapeseed varieties, suitable for being locally cultivated, should pass national or provincial identification and approval[4]; the selected rapeseed varieties should have traits of high yield, high quality, disease resistance, lodging resistance, crack resistance and consistent maturity; the rapeseed-rice-rice triple cropping area should select the early-maturing rapeseed varieties with whole growth period < 190 d, such as Shengguang 127 and Huazao 291.

3 Field preparation

3.1 Returning straw to field After the preceding crop was harvested, the straw crushing machine was used to crush straw and rotary tillage was carried out for stubble cleaning. There should be no excess stubble on the field surface. No tillage and direct seeding for rapeseed required the stubble height of previous crop: rice ≤20 m, corn ≤30 m.

3.2 Weed prevention and control The sterilant herbicide was selected 5 d before sowing rapeseed, and 1125 - 1500 ml 10% glyphosate mixed with 750 kg water per ha was mechanically sprayed uniformly[5].

3.3 Furrowing After furrowing and plot box formation by trencher, the width of plot box should be corresponding to the sowing, harvesting and mechanical application width, box furrow, middle furrow and surrounding furrow should well match, with trench depth of 15 - 20 cm.

3.4 Scientific fertilization Fertilizer application rate per ha: 150 - 240 kg N, 60 - 90 kg P_2O_5, 90 - 135 kg K_2O, 7.5 - 15 kg borax. 50% of nitrogen fertilizer was regarded as basal fertilizer and 100% of phosphorus, potassium and boron fertilizer was as basal fertilizer. The specific fertilizer application rate should be determined based on local agronomic requirements and soil fertility. The granulated fertilizer not easily affected with damp should

be selected when applying the basal fertilizer by combined fertilizer and seed drill.

4 Mechanical sowing

4.1 Sowing date In rapeseed-rice (rapeseed-corn) double cropping area, the sowing date was mid and late September to early and mid October; in rapeseed-rice-rice triple cropping area, the sowing date was mid and late October after the harvest of late rice, not later than November 10.

4.2 Seeding rate Seeding rate was 4.5 – 6.0 kg/ha, and the sowing time should be delayed and seeding rate should be appropriately increased.

4.3 Sowing methods According to the actual cultivation requirements, non-tillage rapeseed seeder, direct rapeseed-sowing machine and precision sowing machine were used for sowing[6], and the operation was conducted according to the equipment instructions.

4.4 Sowing density The suitable direct sowing density of rapeseed was 450000 – 750000 plants/ha[7]. The specific density was determined based on the sowing date and fertilizer conditions. Generally, the density was 450000 plants/ha in mid-September and higher than 750000 plants/ha after the end of October. The density could be moderately low when there were good fertilizer and water conditions.

4.5 Weeding after sowing The chemical weeding was conducted 1 – 3 d after sowing rapeseed, and 750 – 1125 ml 50% acetochlor or 96% metolachlor mixed with 750 kg water was mechanically sprayed per ha.

5 Field management

5.1 Furrow cleaning and drainage of water After the completion of mechanical planting, the furrow was timely cleaned so that the box furrow, middle furrow and surrounding furrow were unblocked, and the field became dry after raining.

5.2 Thinning and final singling Thinning and filling the gaps with seedlings were done during three-leaf period of rapeseed to avoid too high density and seedlingless ridges. The final singling was done during the 4-leaf or 5-leaf period, and 45 – 75 seedlings per m^2 were retained. The seedling density should be moderately increased in the plots with weak fertility.

5.3 Timely topdressing Nitrogen topdressing could be divided into fertilizers for seed bed and overwinter fertilizers, which were applied twice. The fertilizers for seed bed accounted for 20% of total nitrogen consumption, 30 – 48 kg N/ha; the overwinter fertilizers accounted for 30%, 45 – 72 kg N/ha. The fertilizers for seed bed were applied after final singling was done during the 4-leaf or 5-leaf period.

5.4 Weed prevention and control During the 3-leaf or 4-leaf period of weeds, 450 ml 10.8% Gallant super herbicide was mixed with 750 kg water to be mechanically sprayed on Gramineae weeds per ha; 450 – 600 ml 50% Benazolin-ethyl was mixed with 750 kg water to be mechanically sprayed on broadleaf weeds.

5.5 Pest control (i) Aphid control. The rapeseed aphid rate reached 10% in fall, and the pesticide was applied when there were 1 to 2 aphids; 10% of buds were infected with aphids, and the pesticide was applied when there were 3 to 5 aphids. 20% 1∶2000 fenvalerate or 50% 1∶2000 pirimicarb was sprayed for control, and the application rate each time was 1125 kg/ha. The mechanical spraying was conducted on leaves for prevention 1 to 2 times when the morning dew was not dry. (ii) Pieris rapae control. The control started before the third stage of larvae, and 90% 1∶1000 dipterex or 5% 1∶3000 esfenvalerate was sprayed for control. The application rate was 1125 kg/ha, and the mechanical spraying was conducted on leaves for prevention 1 to 2 times when the morning dew was not dry. (iii) Sclerotinia control. During the early flowering period and full-bloom stage, 50% carbendazim wettable powder or 40% 1∶500 dimetachlone was sprayed for control. The application rate was 750 kg/ha, and the mechanical spraying was conducted on leaves for prevention 1 to 2 times when the morning dew was not dry.

6 Mechanical harvesting

6.1 Harvesting period In the rapeseed-rice-rice triple cropping area, the early-maturing rapeseed directly sown was harvested around May 1; in the rapeseed-rice (rapeseed-corn) double cropping area, the rapeseed directly sown was harvested in mid and late May.

6.2 Harvesting methods (i) Segmented harvesting. When siliques turned yellow for 70% to 80% of rapeseed, the harvesting dryer was used for operation. The rapeseed cut down was dried for 5 – 7 d, and after the maturity was more than 90%, the harvesting machine was used for threshing and cleaning. (ii) Combined harvesting. When siliques turned yellow or brown for more than 90% of rapeseed, the combined harvester was used for one-time cutting, threshing and cleaning in the field.

7 Rapeseed cleaning and drying

7.1 Cleaning The wind-type or screening-type cleaners could be used for rapeseed cleaning. The cleaning operation quality should meet the following requirements: cleanliness ≥ 99%; loss rate ≤ 0.8%.

7.2 Drying[8] When the original water content of rapeseed > 18%, the maximum hot air temperature was 90 ℃ under mixed flow drying mode; the maximum hot air temperature was 110 ℃ under roller drying mode; the maximum hot air temperature was 90 ℃ under fluidized bed drying mode. When the original water content of rapeseed was 12% – 18%, the maximum hot air temperature was 110 ℃ under mixed flow drying mode; the maximum hot air temperature was 130 ℃ under roller drying mode; the maximum hot air temperature was 120 ℃ under fluidized bed drying mode. When the original water content of rapeseed < 12%, the maximum hot air temperature was 130 ℃ under mixed flow drying mode; the maximum hot air temperature was 150 ℃ under roller

(To page 88)

before germination to trigger branches; meanwhile, the small main branches should increase open angle as soon as possible, shifting from the original September to May, in order to ease growth potential. The trunk taperingness of slender-spindle short-shoot Fuji apple is negatively correlated with the total thickness but positively correlated with other factors, and the correlation with average length reaches a significant level, so there is a need to increase the number of small main branches in order to obtain ideal slender-spindle tree shape and reduce the total thickness. Fundamentally, the transformation of different tree structure is to meet the needs for optimal lighting conditions required by the production of high quality fruits. Studies show that if the lighting conditions are good for trees, the fruit quality is good and the blossom buds also increase significantly[11]. Thus, for the dwarf high-density garden, the light inside crown can reach an optimal state by bud-notching, earlier expansion of the branch angle, adjustment of branch bending time, elevation of trunk height and other shaping measures[10, 12-13].

References

[1] MA BK, XU JZ, SUN JS. Consideration for high density planting with dwarf rootstocks in apple in China[J]. Journal of Fruit Science,2010,27(1):105-109. (in Chinese).

[2] QI JJ. The study on the effects of bending branch and and notching bud of vigorous rootstock apple trees[D]. Baoding:Hebei Agricultural University,2013. (in Chinese).

[3] WANG JZ, XUE XM. On the intensive and high-efficiency cultivated mode and the key of dwarfing interstock in Shandong[J]. Shandong Agricultural Sciences,2013,45(11):125-128. (in Chinese).

[4] FENG JZ. On the technique of establishing dwarfing interstock orchard [J]. Modern Rural Science and Technology,2007(1):60. (in Chinese).

[5] LI BZ. On the technique of establishing dwarfing interstock orchard and pruning the branches of saplings[J]. Northwest Horticulture,2010(10):13-15. (in Chinese).

[6] WANG XL. Effects of the stem height and plant growth regulator on branches features of apple saplings[D]. Yangling:North West Agriculture and Forestry University,2014. (in Chinese).

[7] ZHANG MR. Effects of different branch angle on the growth and development of apple and its related physiological properties[D]. Yangling: North West Agriculture and Forestry University,2013. (in Chinese).

[8] HAN MY, LI YW, FAN CH, *et al.* Effects of branch bending angle on physiological characteristics and fruit quality of Fuji apple[J]. Acta Horticulturae Sinica,2008,35(9):1345-1350. (in Chinese).

[9] ZHANG W. Research of different branch angle and clip quantity on Fuji apple canopy structure growth and fruit infruence[D]. Yangling:North West Agriculture and Forestry University,2010. (in Chinese).

[10] LI ZY, HAN LH, GUO J, *et al.* Effect of the stem height on the growth and development of dwarfing interstock saplings[J]. China Fruits,2013(5):18-21. (in Chinese).

[11] RUAN BL. Study on the effect of different degree of pruning in modifying tree forms on growth, fruiting and photosynthetic ability[D]. Yangling: North West Agriculture and Forestry University,2004. (in Chinese).

[12] AISHAJIANG MMT, YANG Q, WANG JJ, *et al.* Effects of cutting back, branch-bending and bud-notching treatments on endogenous hormones in the buds of Fuji apple[J]. Acta Horticulturae Sinica,2013,40(8):1437-1444. (in Chinese).

[13] AISHAJIANG MMT, ABUDUWAILI MU MN, *et al.* Effects of cutting back and branch-bending on photosynthetic characteristics of new shoots [J]. Journal of China Agricultural University,2013,18(6):126-131. (in Chinese).

(From page 85)

drying mode; the maximum hot air temperature was 140 ℃ under fluidized bed drying mode. The maximum hot air temperature was 60 ℃ for the rapeseed in the mixed flow drying process. After drying, the rapeseed must not have burnt seeds, water content should be equal to or lower than 8%, and moisture unevenness should be equal to or lower than 2%.

References

[1] ZHOU GS, ZUO QS, LIAO QX, *et al.* Mechanical production status, existing problems and strategy discussion of rapeseed in China[J]. Hubei Agricultural Sciences, 2013, 52(9): 2153 - 2156. (in Chinese).

[2] NY/T 2208 Technical specifications for rape full mechanized production [Z]. (in Chinese).

[3] NY/T 2546 Technical regulation for rapeseed mechanization in rapeseed-rice-rice region[Z]. (in Chinese).

[4] NY/T 414 Low erucic acid low glucosinolate rape seed[Z]. (in Chinese).

[5] NY/T 1225 Technicals pecincation of safety application for operateds prayers[Z]. (in Chinese).

[6] ZHANG YW, ZOU J, ZHANG WC, *et al.* Precise seeding technology for rape and development of multi-functional precise seeding apparatus[J]. Chinese Agricul Tural Mechanization, 2003 (2): 28 - 30. (in Chinese).

[7] XU SW, WEI X, WU DM, *et al.* Effects of different factors on yield of no-tillage direct-seeding rapeseed [J]. Hubei Agricultural Sciences, 2015, 54(15): 3602-3605. (in Chinese).

[8] NY/T 1087 The technical regulations of rapeseed drying and storage[Z]. (in Chinese).