National Agricultural Extension and Research Liaison Services
Federal Ministry of Agriculture and Water Resources
Ahmadu Bello University, Zaria

GARLIC PRODUCTION UNDER IRRIGATION

EXTENSION BULLETIN NO 205
Agric. Engineering Series No 6

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Produced and Distributed By

National Agricultural Extension and Research Liaison Services,
Ahmadu Bello University,
P. M. B. 1067,
Zaria.

Acknowledgement

The authors express their appreciation to Agric engineering and irrigation Programme staff for their contributions in preparing the manuscript; we also acknowledge the valuable comments of external reviewers of the bulletin. The financial support provided by NAERLS management for production of this bulletin is highly appreciated.

S.S.Abubakar, G.B.Murtala, Sani Inusa and M.M Jaliya

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1.0 INTRODUCTION

Garlic (Allium Sativum) is an important spice crop belonging to the family Alliaceae along with onion, shallot and chives. They are about 40 cm tall when fully grown. The leaves of onion, shallot and chive are cylindrical and hollow while that of garlic are flat and very slender. All the leaves arise from the swollen stem that takes the form of a bulb. Garlic bulbs consist of small bulbils, which range from 6-50 commonly called cloves. Medina, et al (1960). Garlic plant, the green tops as well as the bulbs are principally used as spice for flavouring and seasoning vegetable and meat dishes, it gives the food a delightful fragrance. It is usually dehydrated for industrial and home use. Its folk medicinal use includes treatment of whooping cough, lung diseases, stomach complaints (as healing of ulcers of the intestines) and disorders resulting from child birth and as a specific for colds, sore eyes and ear-ache; Kostalova, (1982). Its ability to protect crop against a variety of fungal and bacterial diseases has been scientifically proven by researchers at the University of California in Berkley.

1.1 Origin and Distribution

Garlic is believed to have originated from central Asia and later spread to the Mediterranean and was later carried to the Western world probably by the Spanish, French and Portuguese (Pureglove, 1972). The crop spread to Africa and Nigeria probably through the activities of English colonialist and Arab traders. It is observed to be growing in the fadama areas of Sokoto, Kano, Borno and some irrigation projects mainly under irrigation during the dry season between November to March when the temperature is low.

2.0 CLIMATIC AND SOIL REQUIREMENTS

*2.*1 Climatic requirements Garlic is adapted to tropical and sub-tropical condition. It survives well in areas with 600-1200 mm annual rainfall with temperatures ranging between 5-25 °c to 25-40 °c. Excessively hot and long days are not conducive to proper bulb formation. Garlic tolerates morning and evening relative humidity in the range of 15-80 percent and 15-70 percent respectively. High relative humidity favour disease build up.

2.2 *Soil* requirement*:* Select a well-drained fertile loamy soil free from stone and gravels. The site should be close to a reliable source if irrigation water. Heavy soils are not suitable for garlic production, as the bulbs produced under such condition will have the bulb been deformed, also difficulties may occur in harvesting. The cutting and pulling out of the bulbs results in badly broken and bruised bulbs which do not keep well in storage. In poorly drained soil, the bulbs will get discoloured

3.0 LAND PREPARATION

Land preparation is very necessary and this involves ploughing and harrowing to pulverize the soil before making ridges or constructing basin for planting of the garlic cloves. The land may further be pulverized manually in order to smoothing it very well.

3.1 Basin Formation

After getting the land well pulverized and leveled, then formed your basin to the size of 2 m x 1.5m (net) or any suitable size depending on soil type field gradient and irrigation water stream size. This is to allow for easy irrigation water control in the field.

4.0 PLANTING

4.1 The planting date for garlic can be critical in northern Nigeria where garlic is mostly grown; it is recommended that garlic be planted between November and March during which the weather is cool.

4.2 Recommended Varieties

No distinct variety of garlic has so far been released in Nigeria, but many types are available with farmers across the country with varying characteristics such as size, shape, colour, yield, time of maturity, ease of bolting, pungency, storability , resistant to pest and diseases etc .It is recommended that farmers should select varieties with desired qualities for plating.

4.3 Seeds Preparation And Treatment

Garlic cloves or bulblet are usually used as seed for planting, select popular cultivars, large cloves with highest size (usually 8-12 grammas} for planting. It is generally believed that outer cloves give higher yields than the inner ones from the same bulbs, however, field trials conducted to verify this belief have shown no significant differences in yields. Before planting, detach the bulblets from the bulbs and soak in clean water for at least six (6) hours, then remove the outer skin from the bulblets and later drain the water and dries it with a mixture of fungicide and insecticide to control fungicides and seed attacking insects. These will enhance vigorous germination with minimal loss of seeds and seedlings.

4.4 method of planting*:* Garlic can either be planted by dibbling, drilling or broadcasting. Dibbling method is mostly practiced and it consist of placing one clove per hole with the growing point upwards placed into the soil 3-6cm deep and 7 cm apart in rows of 15cm apart and cover lightly with soil. A total of 350 to 600kg cloves is required per hectare which may provide up to 400,000 to 500,000 plants per hectare.

5.0 IRRIGATION PRACTICES.

When rainfall is not sufficient or when producing garlic during dry season, the garlic must receive additional water from irrigation, various methods can be used to supply irrigation water to the crop.

A simple irrigation method is to bring water from the source of supply e.g. a well to the crop with a bucket or a watering can. This can be a very time-consuming method and involves very hard work. However, it can be used successfully to irrigate very small plots of garlic that are close to the water source.

More sophisticated methods of water application are used when larger plots of garlic require irrigation. Commonly used methods include surface irrigation, sprinkler and drip irrigation.

5.1 Surface Irrigation

Surface irrigation is the application of water by gravity flow to the surface of the field. Either the entire field is flooded (basin irrigation) or the water is fed into small channels (furrows) or strips of land (boarders). Furrow and boarder irrigation methods are seldom used by garlic farmers, therefore were not discussed here. Of all the surface irrigation methods, basin irrigation is the most widely practiced by garlic farmers due to its simplicity in operation and maintenance and efficiency in water control. Basins are flat areas of land, surrounded by low bunds; the bunds prevent the water from flowing to the adjacent fields.

The shape and size of basins are mainly determined by the land slope, the soil type, the available stream size (the water flow to the basin), the required depth of the irrigation application and other farming practices.

Generally basins should be small if:-

- slope of the land is steep
- soil is sandy
- stream size to the basin is small
- required depth of the irrigation application is small
- field preparation is done by hand or animal traction.

Basins can be large if:-

- slope of the land is gentle or flat
- soil is clay
- stream size to the basin is large
- required depth of the irrigation application is large.

5.2 Irrigating Basins

Basins are irrigated through direct or cascade methods. The direct method of water application to basins is done through leading water directly from the field channel into the basin through the use of siphons, spiles or bund breaks; while the cascade method involves supplying water to the highest basin on sloping land and then allowed to flow to a lower basin and so on until the lowest basin is filled.

To obtain a uniformly wetted root zone, the surface of the basin must be level and the irrigation water must be applied quickly. Poor wetting patterns can be caused by:

- poor layout e.g. a poorly leveled surface;
- poor management e.g. supplying incorrect stream size, applying too little or too much water.

5.3 Irrigation Frequency

How much and how often water has to be applied depends on the irrigation water need of garlic. The irrigation water need is defined as the crop water need minus the effective rainfall. It is usually expressed in mm/day or mm/month. A simple method may be used to determine when (and how much) to irrigate. This is done through taking a handful of soil and squeezing it tightly. The consistency of the squeezed soil roughly indicates when the drought limit is reached and irrigation is necessary. Compare consistency of the squeezed soil ball with table 1 to find when to irrigate.

Table 1 consistency of a soil ball formed by hand and amount of water necessary (in mm per 10 cm depth of effective root zone) at drought limit to bring the soil back to field capacity (Israelsen and Hansen, 1962)

Texture	Coarse (sand)	Moderately (coarse)	Medium	Fine day
Consistency at drought limit	Soil does not form ball, appears to be dry.	Soil tends to form ball, however, it seldom holds together.	Soil forms a plastic, sometimes sticky ball.	Soil forms ball, ribbons out between thumb and forefinger.
MM water required per 10 cm soil depth	1.5 – 4.0	3.0 – 6.5	4.0 – 8.0	5.0 – 10.0

The amount of irrigation water which can be given during one irrigation application is limited the maximum amount which can be applied has to be determined and may be influenced by:

- soil type
- root depth.

At the beginning of the season, the amount of water applied to garlic per irrigation (depth) is small and given frequently, this is due to low evaporation of the young garlic and their shallow root dept. During mid-season, the irrigation depth should be larger and given less frequently due to high evaporation and maximum root depth. Table 2 provides the estimated irrigation frequency depending on soil type.

Table 2 Estimated Irrigation schedule for Garlic during peak water use period.

Crop	Sandy soil		Loam soil		Clay soil	
	Interval (days)	Net Irrigation depth (mm)	Interval (day)	Net Irrigation depth (mm)	Interval (day)	Net Irrigation depth (mm)
Garlic	3	15	4	20	7	30

The last irrigation should be given 2-3 days before harvesting to soften the soil, thus making harvesting easy without damaging the bulbs.

5.4 Lack of Water: Lack of water is the most common stress. The garlic does not compensate for drought periods by prolonged growth. Even a short period of drought affects the yield, especially during bulb expansion. Bulbs infestation by insects is also favored by lack of water.

Water stress influences yield directly by restricting transpiration and photosynthesis. Indirectly it leads to reduced evaporation from soil and leaves, increasing soil and plant temperature. High temperature is unfavorable for bulb formation.

5.5. Excess Water

Excess water may be caused by heavy rainfall, heavy irrigation, or inefficient drainage.

Too much water prevents oxygen from reaching underground parts of garlic resulting in poor root development and rotting of the newly formed bulbs. Seed bulblets are especially susceptible to bulb rot. Over irrigation

shortly after planting may reduce emergence, also may cause rot before harvest.
High moisture favors development of late blight disease. Excess water results in waste due to percolation or surface run-off. It also increases erosion.

5.6. Variation of Soil Moisture

Excessive variation in soil moisture affects bulb quality; water after a prolonged drought may cause second growth. Bulbs formed irregular shapes and may crack. New haulm growth may be at the expense of bulb yield.

5.7. Rain fed Garlic Production

In rain fed garlic production, the amount of soil water at planting time plus additional rainfall during the growing season sometimes is sufficient for garlic production. Rainfed garlic production in Nigeria is inhabited mostly by erratic rainfall and prevailing high temperatures during rainy season, which limits bulb, yield of garlic.

6.0. Fertilizer and its Application: Most tropical soils are likely to be deficient in one or more of the essential elements, and for crops including garlic, fertilizer and or manure application is required especially on soil that are poor in plant nutrients. This is to make up the difference between what the crop requires and what the soil can supply. Apply twenty (20) tons of well-rotted farm yard manure per hectare to the field at land preparation. Alternatively apply mineral fertilizer at the rate of 45:30:30 NPK per hectare. For good crop growth, high yield and top produce quality, it is recommended to apply the phosphorous and potassium fertilizer dose at planting while the nitrogen dose should be applied in two splits of 3 and 6 weeks after planting.

7.0 WEeding: Weeds are usually the troublesome unwanted plants of various shapes and sizes found growing among the cultivated garlic crop they cause a lot of damage during growth period. Garlic field should be weeded as often as possible to reduce weed competition especially during the first eight (8) weeks of growth. When the crop starts bulbing, weeds should preferably be pulled out with hand to avoid root injury. Chemically propyzamide in combination with diuron at recommended quantity was found to be effective as pre-emergence or as early post emergence when garlic is at 2 to 3 leaf stage of growth.

8.0 PEst and Diseases management: Like onion, different types of pest and diseases also attack garlic. Some of the main pest of garlic includes: Thrips tabaci, laodipax stratella, Hylemya Antigua, carpophilus sp, and a number of mites such as Rhizghypha echmopus. The insect feeds on the crop and cause serious damage that may inhabit or retard growth. Serious diseases such as white rot stem rot and bulb nematodes are preponderant in garlic, and are usually distributed by planting of diseased stock or planting on land that is inpected with such diseases. Garlic of poor quality and those that are from unknown sources should be avoided to ensure pest and diseases free planting materials.

9.0 HArvesting:

9.1. Maturity Period and Sign. Garlic bulbs are harvested at optimum maturity period when the plants are eighteen (18) weeks old. The crop is usually ready for harvesting when the tops becomes partly dry and bend to the ground, the plant will turn yellowish or brownish, usually about a month or so after the emergence of seed stalks. Harvesting too early decrease total yield and reducing quality of the bulb, it will also cause rapid deterioration during storage.

9.2. Harvesting Technique. The bulbs are cut below the fibrous roots using hand hoe or tractor drown implement, the bulb and plant are pulled up by hand, freed from the soil and the leaves tied at the top for easy drying.

9.3. Bulb Curing: Garlic bulbs are usually cured before storage. The bulbs are cured for three (3) to four (4) days in shady places. This involved the provision of adequate ventilation and dry air to harvested garlic so that the storage quality of the crop will be improved. Before curing the tops are removed and bulbs of garlic are often placed in jute sacks in an open well ventilated shade to cure or a spread to a thickness of about 5cm in a shade.

9.4. Quality of Bulbs and Yield. In every crop production practice, one of the major aims is to obtain high yield and good quality of the produce. This is usually achieved after taking necessary measures during production operation. Early planted garlic gave higher number of cloves per bulb and greater bulb weight per plant then the late sown crop. up to sixteen (16) tons per hectare can be obtained from irrigated garlic under good management.

9.5. Storage. Thoroughly cured garlic bulbs keep fairly well in an ordinary well ventilated room. Losses incurred in ordinary storage were observed to be low during the first five months of storage period from May to September. There are no significant differences in loss between garlic stored with the top and the untapped stored bulbs. These losses are mostly due to rot toning if bulbs are to be stored for any length of times, the following recommendation should be observed.

I. Before storage, damaged and diseases bulbs should be sorted out from healthy ones.
II. Store must be thoroughly cleaned between each storage period.
III. Bulbs should not be stored in damp conditions which favours the spread of certain diseases.

IV. The store should be as cool as possible. Mud houses with thatched roofs are preferable to the houses roofed with galvanized iron sheet.
V. Rodents should be prevented from getting access into the store.
VI. Regular inspection of the store to remove all diseased bulbs is very necessary.

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Designed And Printed By NAERLS Press