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Research Application Summary

Effect of drip irrigation system and fertigation on growth, yield and quality of banana cv. Grand Nain (*Musa AAA*)

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Abstract

Banana cv. Grand Nain is a newly released cultivar in Sudan with high yield potential and less sensitivity to cool temperature. There is a high demand for exporting this cultivar which will replace the widely grown banana cv. Dawarf Cavendish. Presently, Grand Nain is becoming a popular banana cultivar in Sudan, but the yields are low due to lack of proper water management and fertilization. Crop management (crop water use) and other factors are not well determined under Sudan conditions. This study was conducted to determine the effect of drip irrigation system and fertigation on growth, yield and quality of banana cv. Grand Nain. We studied water quantity and efficiency with fertigation in comparison to farmer practice. The preliminary results indicated that the amount of applied irrigation water with drip irrigation system was lower than that needed under surface irrigation. The banana under drip irrigation system performed better in plant growth and flowered earlier in comparison with surface irrigation.

Key words: Banana, drip irrigation system, efficiency, fertigation, Grand Nain, surface irrigation

Résumé

Le bananier cv. Grand Nain est un cultivar nouvellement libéré au Soudan avec un potentiel de rendement élevé et une moindre sensibilité à la température fraîche. Il ya une forte demande pour l'exportation de ce cultivar qui remplacera le bananier cv. Dawarf Cavendish largement cultivé. Actuellement, le Grand Nain est devenu un cultivar de bananier populaire au Soudan, mais les rendements sont faibles en raison de l'absence de gestion adéquate de l'eau et de la fertilisation. La gestion des cultures (utilisation de l'eau des cultures) et d'autres facteurs ne sont pas bien déterminés dans les conditions du Soudan. Cette étude a été menée pour déterminer l'effet du système d'irrigation par gouttes et la fertilisation sur la croissance, le rendement et la qualité du bananier cv. Nain Grand. Nous avons

étudié la quantité d'eau et l'efficacité avec la fertilisation par rapport à la pratique des agriculteurs. Les résultats préliminaires indiquent que la quantité d'eau d'irrigation appliquée avec le système d'irrigation par gouttes a été inférieure à celle nécessaire en vertu de l'irrigation de surface. Le bananier sous le système d'irrigation par gouttes a donné de meilleurs résultats en croissance des plantes et a fleuri plus tôt par rapport à l'irrigation de surface.

Mots clés: Bananier, système d'irrigation par gouttes, efficacité, fertilisation, Grand Nain, irrigation de surface

Background

Bananas and plantains are the fourth most important food crop in the world after rice, wheat and maize (Salvador *et al*., 2007). In Sudan the areas under banana cultivation are now more than 12700 hectares. The crop is well adapted to the warm dry climate and productivity exceeding 50 ton/ha have been achieved under light fertile soils of the Gash river basin and the Nile river banks. Generally banana in Sudan is irrigated by surface irrigation, which requires more water and faces many problems (Walker, 1989). This is of particular importance since the amount of water present in the universe is only about 1520 million cubic kilometers, 97% is ocean water and sea salt, 2% is frozen arctic waters and only 1% is water lakes, rivers and underground water, which is potable water for direct use to humans (Shaker, 2004). Drip irrigation (trickle or micro irrigation) is a promising system for economizing on the available irrigation water. It is also necessary to manage the available water efficiently for maximum crop production. Drip irrigation can apply water both precisely and uniformly at a high irrigation frequency compared with furrow and sprinkler irrigation, thus potentially increasing yield, reducing subsurface drainage, providing better salinity control and better disease management since only the soil is wetted whereas the leaf surface stays dry (Hanson and May, 2007).

Application of fertilizers through drip irrigation system (fertigation) can reduce fertilizer usage, minimize leaching by rain and excessive irrigation, maximize the fertilizer use efficiency, allows flexibility in timing fertilizer application, and reduces the labour required for applying fertilizer. Drip irrigation systems are well suited to fertigation because of their reduced frequency of operation and because water application can be easily controlled by the manager (Brad Lewis, 2001).

Literature Summary

Irrigation is the artificial application of water for the purpose of crop production. Irrigation water is supplied to supplement the water available from rainfall and the contribution to soil moisture from ground water (Michael, 1978). Goenagea and Irizarry (2000) conducted a study on yield performance of banana (Grand Nain) irrigated with fraction of class A pan evaporation. The result showed that irrigation according to increasing pan factors resulted in increase in bunch weight, fruit diameter and length, number of hands per bunch and number of leaves at flowering and at harvest. Some studies were done to compare drip irrigation with surface irrigation. Thadchayini and Thiruchelvam (2005) reported the highest banana yield of 41,000 kg/ ha in the drip which was 31% higher than surface irrigation. Hegde and Srinivas (1991) reported an increase in the banana yield under drip irrigation compared with basin irrigation. Hand bunch and finger weight were also higher in drip. Plants were taller (3%) and flowered 15 days earlier under the drip than the basin irrigation. Fertigation can save from 20% to 50% in fertilizers, while improving the yield and quality as compared with the common methods of fertilizer application (Malakouti, 2004). Arscott (1970) reported that application of urea through irrigation system was more efficient than hand broadcasting on soil surface on banana. More yield and significantly higher number of hands per bunch were obtained with fertigation.

Study Description

The experiment was established at Horticultural Research Center Farm, Agricultural Research Corporation (ARC) Sudan. Six months old planting material propagated by tissue culture was transplanted in the field on 16th of November, 2009 at spacing of 3×3 meter (1111 mother plants / ha) and every plant received 10 kg organic manure. Three months after planting two sukers were left at flower (2222 plants / ha) population. The daily metrological data were used to compute reference evapotranspiration (ET_o). Five different quantities of irrigation were applied at 2 days interval compared with farmers practice (surface irrigation) every 5-7 days. These were 40%, 60%, 80%, 100% and 120% of crop evapotranspiration (ET_c) under drip irrigation.

A drip irrigation system was designed and installed on the area of 2145 m^2 and two emitters per plant were used, the discharge of one emitter was 8 l/h. The recommended fertilizer dose was added by fertigtion in drip irrigation treatments and by hand (Traditional method) in surface irrigation treatment. The treatments were replicated 4 times in randomizes complete block

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design (RCBD) and 4 plant per replication. Data on plant growth cover (%), pseudostem height (cm), pseudostem girth (cm) and total number of leaves per plant were measuring at 6 months after planting and at flowering. At harvest data will be collected on the yield and quality parameters. After harvest plant tissue analysis will be done to establish irrigation water use efficiency (kg/m^3).

The quantities of water applied to the banana (from 16th-November-09 to 30th - July-10) were 107 m^3, 129 m^3, 150 m^3, 173 m^3 and 194 m^3 under drip irrigation treatment (40%, 60%, 80%, 100% and 120% of (ET_c), respectively) compared to 354 m^3 for surface irrigation (Fig. 1). The study on the hydraulic characteristic of drip irrigation system gave 7.92 l/h for average emitters discharge, 90.9% filed emission uniformity, 86.8%

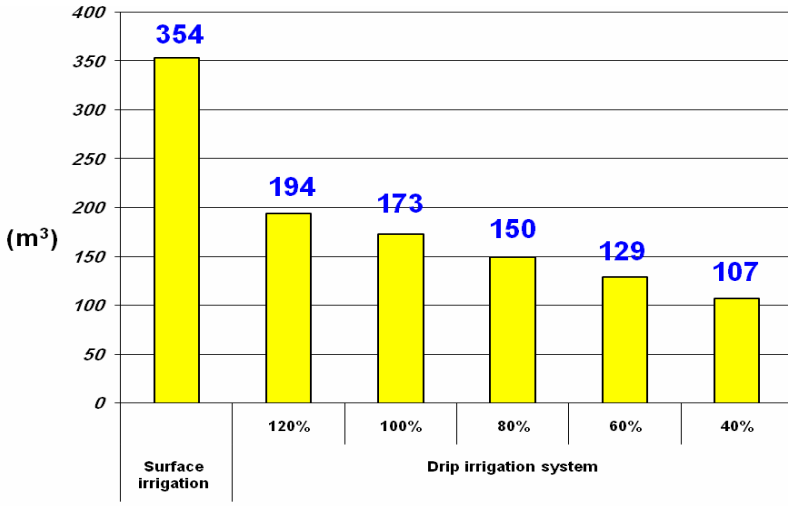

Figure1. The quantities of water (m^3) applied by drip and surface irrigation for banana (From 16th-November-09 to 30th - July-10)

Table1. Growth parameters of cv. Grand Nain at 6 month after planting under different treatments.

Treatments	Pseudostem height (cm)	Pseudostem girth (cm)	Number of leaves per plant
40% of ET_c under drip irrigation	101.3	34.1	11.2
60% of ET_c under drip irrigation	86.9	33.9	12.4
80% of ET_c under drip irrigation	112.8	35.9	13.13
100% of ET_c under drip irrigation	114.7	35.8	13.3
120% of ET_c under drip irrigation	120	34.6	13.98
Surface irrigation	110.8	34.8	13.15
F-prob	0.115	0.93	0.066
CV%	15.1	8.9	9.1

absolute emission uniformity and 91.9% design emission uniformity. Better growth parameters were found in 120% and 100% of ET_c under drip irrigation system compared with surface irrigation (Table 1).

Time to flowering (shooting) started earlier in 100% followed by 120%, 60%, 40% and 80% of ET_c, respectively.

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