The effect of ridging and soil mulching on growth and yield of cassava grown after rice with no irrigation in Northeast Thailand: A preliminary results

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Summary: An experiment was conducted in a famer's field at Wang-wa in Khon Kaen province, Northeast Thailand. The objective of this study was to investigate the effects of ridging and surface soil mulching on growth and yield of two cassava cultivars grown after rice with no irrigation in Northeast Thailand. A field monitoring system (FMS) and soil moisture sensors were installed to automatically monitor and record the climatic and soil moisture data in real-time. A split-split plot design was used in this study. Comparison of ridging and flat soil planting were assigned as the main plot treatments, mulching and no mulching as the sub effect, KU-50 and Rayong-11 cultivars the sub-sub effect. Cassava was planted on 26 November 2012 and plant growth data were recorded at 30, 60, 90, 120, 150 and 180 days after planting. In case of surface soil mulching with rice straws, results of KU-50 showed that flat soil planting provide resulted better crop survival ratio (91%) than ridging (76%) and for Rayong-11, flat soil planting did better (86%) than ridging (51%). With no-mulching, the survival ratio of planting on ridges was higher (90%) than flat soil planting (86%) for KU-50, and for Rayong-11 planting on ridges lower (70%) than flat soil (75%). This study indicated that KU-50 better adapted than Rayong-11 in sandy soils for planting in the dry season with no-irrigation. The survival ratio of planting on ridges was lower than on flat soils at the initial stage.

1. Introduction

Most of the arable lands in Northeast Thailand are typical tropical sandy, acidic and infertile. Sandy loam and loamy sand soil surface textures cover about 49.86% and 10.67%, respectively, of the total area of the region (Wattana, 2010). According to Koppen's system, the climate belongs to tropical savanna characterized by rainy and the dry seasons. In general, mono-cropping of rice is grown in the paddy fields in the rainy season (July-November). In dry season, most paddy fields left as fallows due to inadequate soil moisture for crop production. Irrigation systems are not well established and a large part of the arable land, especially the paddy fields, remains under rain-fed conditions (Wada, 2005). Ninety-five percent of agricultural activities are carried out in rain-fed areas in the Northeast Thailand (Somsak et al, 2012). Regarding the environmental conditions and insufficient water supply during dry season, some famers had grown cassava after rice using residual soil moisture and rainfall at early rainy season (Dec.-June.) to generate farm income. Cassava (*Manihot esculenta*) is a drought tolerant crop and well adaptes to the poor soil in Northeast Thailand (Barnaud et al, 2007). The objective of this study was to investigate the effect of ridging and surface soil mulching on growth and yield of two cassava cultivars grown after rice with no irrigation in Northeast Thailand.

2. Materials and Methods

1) Study site

The experiment was conducted at a famer's field in Wang-wa village (16°11′53″ N, 102°48′58″ E) at an elevation of 206 msl (mean sea level), which is located about 40 km from Khon Kaen city in northeastern Thailand (Fig 1).

2) Soils and Land preparation

Soil samples were taken from 0-15 cm and 15-30 cm depths before planting cassava and pH, organic matter (OM), total-N, available-P, exchangeable-K, cation exchange capacity (CEC), bulk density, field capacity (FC) and permanent wilting point (PWP) were determined. A five-wheel tractor was used for preparing the land, plowing and constructing ridges. The ridges were approximately 0.4 m high.

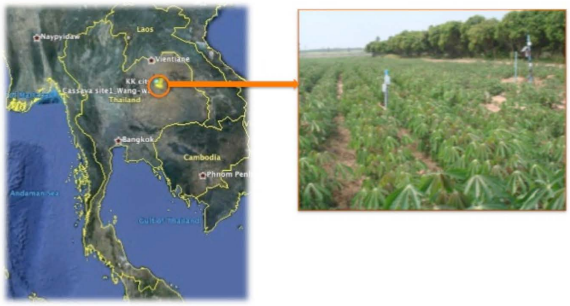

Fig.1 The study area of cassava in Khon Kaen province, Thailand.

3) Experimental Design

Two cassava cultivars named "KU-50" and "Rayong-11" were used in this study. Cassava was planted on 26 November 2012 after rice harvested in October 25, 2012. A split-split plot design with 3 replications was used in this study. The field-level drainage (ridging and flat soil planting) was assigned as the primary factor, the soil evaporation control (mulching and no-mulching) assigned as the secondary factor. We monthly observed growth of the cassava 30, 60, 90, 120, 150, and 180 days after transplanting. And cassava harvesting will be done by the end of May 2013.

4) Cassava cultural practices

The cassava mature stems were cut into sections (15-20 cm length) as planting materials (cassava stalk). Cassava stalks were planted vertically in 0.6 x 1.0 m arrangement in the ridging and flat soil planting treatments. For mulching treatments, rice straws were placed on the soil surface on 27th November 2012. There was no supplement water by irrigation in the entire growing season.

5) Field monitoring system (FMS)

A FMS (X-ability, Col, Ltd, Tokyo, Japan) had been running at the study sites since October 20th, 2012. This system was composed of an automatic rain gauge, an anemometer, a temperature sensor and a camera. The data can be accessed and downloaded via a web server. The FMS sends the image data for the field via the camera at 12 pm (Thailand standard time) every day. By using this system, the meteorological data such as rainfall, solar radiation, wind speed, wind direction, air humidity, and air temperature can be continuously collected.

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6) Soil moisture and soil temperature monitoring

Decagon 5TE sensors were used to monitor soil moisture and soil temperature hourly at the depth of 4, 8, 16, 32, and 64 cm in the cassava field. All sensors were connected to an Em50 data logger. The sensors have been running to collect the data in the areas of ridging and flat soils planting with mulches and with no-mulch by using rice straws.

3. Results and discussion

3.1 Environmental conditions

3.1.1 Rainfall and air temperature: There is no rainfall until 30 days after transplantation (November 26th, 2012) in the study area.

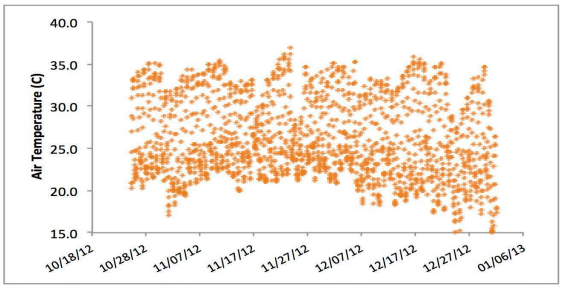

Fig.2 Changes of air temperature in Wang-wa cassava field

Figure 2 shows changes of air temperature over cassava field at Wang-wa village hourly recorded by the field monitoring system in real-time. The maximum, minimum, and average air temperatures were 37 °C, 14.20 °C, and 26 °C respectively.

3.1.2 Soil moisture and soil temperature:

Fig.3 shows, changes of soil moisture at the depths of 4, 8 and 16 cm in the cassava field (at Wang-wa village). The results show that soil moisture has been continuously decreasing from October to December 2012 because there was no rain during that period. At the date of planting, soil moisture value was about 4% to 6% for the 4 to 16 cm depths.

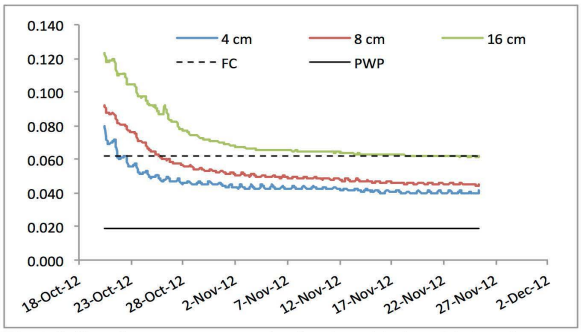

Fig.3 Soil moisture content at the depths of 4, 8 and 16 cm in cassava field after harvested rice

3.2 Cassava cultivar

We observed survival ratio of cassava at the early stage (at 30 days after planted). The results showed that KU-50 well geminated and had a higher survival ratio (85%) than Rayong-11 (70%) of the total population (total N=864 samples/cultivar), respectively (table 1).

3.3 The survival ratio of cassava

3.3.1 Ridging with mulching and no-mulching: Cassava planted on ridges with mulch unable to survive (76%) as those that without mulching (90.28%) respectively, for KU-50. As for Rayong-11, the survival ratio of the plants plated on ridges with mulching was also lower (51%) than non-mulching (70%) respectively.

3.3.2 Flat soil planting with mulching and no-mulching: The KU-50 planted on flat soil with mulching (91%) was growing greater than that planted with non-mulching (86%). For Rayong-11, results show that cassava planted on flat soils with mulching (86%) was growing better than without mulching (75%).

Table 1 Survival ratio (%) of KU-50 and Rayong-11 at 30 days after planting at Wang-wa village.

Field drainage	Soil mulching	Cassava cultivar	
		KU-50	Rayong-11
Ridging	Mulching	76	51
	No-mulching	90	70
Flat soil planting	Mulching	91	86
	No-mulching	86	75
Total survival (%)		86	70

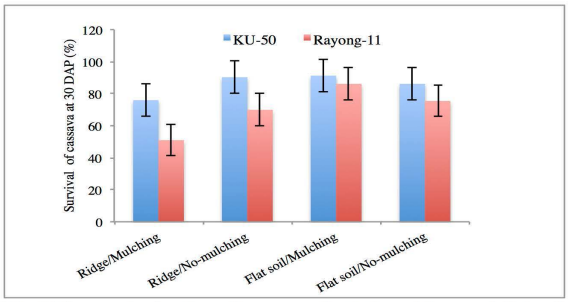

Fig.4 The survival ratios of cassava planted on ridges and flat soil with mulching and no-mulching by rice straws

4. Conclusions

Two cultivars of cassava planting after rice on sandy soils in rain-fed areas of Khon Kaen with no-irrigation indicated that KU-50 grows better than Rayong-11 at the initial stage (30 days after transplanted) and also KU-50 achieves a greater crop survival ratio than Rayong-11. We also found that the survival ratio of cassava planted on flat soils was higher than that planting on ridges. In case of mulching and no-mulching, the results show that crop survival ratio for no-mulching better than for mulching with rice straws.

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