

IRRIGATING SUGARCANE WITH VERY LOW FURROW INFLOW RATES

By

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Abstract

SPRINKLER irrigation of sugarcane is a common practice at the foothills of the Cauca river valley of Colombia. Energy costs are limiting the use of this irrigation system and alternative ways of irrigation using small surface springs is under evaluation. Water is applied by gravity using small furrow inflow rates in the range of 0.1 to 0.3 L/s while furrow irrigation of sugarcane on the flat areas uses inflow rates above 5 L/s. Water is diverted from the small streams and conducted to the fields using small hydraulics heads (less than 10 m). Cheap pipelines of 100 mm diameter, made of recycled polyethylene bags, are used to conduct the water at low pressure heads to the fields where water is applied to the furrows using plastic tubing of 6 to 16 mm in diameter. Furrow lengths of 100 to 120 m with slopes above 1% are irrigated during the advance phase in 20 to 24 hours applying water depths in the range of 100 to 130 mm. Cane yields in the order of 84 t/ha were obtained, which compare very well with the production of the sprinkle-irrigated plots.

Introduction

In the Cauca river valley of Colombia, there are 205 664 ha of cane planted. Of this area, 62 636 ha are in the foot hills of the central and oriental mountain chains. The cropped area is characterised by the presence of shallow depth soils, and high gravel content (20 to 50%); therefore, water holding capacity and fertility levels are low. During dry spells, it is necessary to sprinkle irrigate the cane fields, which results in high energy inputs, high water consumption and high soil erosion risk due to terrain slopes above 1%.

Bohorquez and García (1985) in Venezuela applied very low furrow inflow rates to improve irrigation efficiencies in an area with low surface water availability. Díaz and Prieto (2000) evaluated the application of low inflow rates (0.1 L/s) to irrigate sugarcane in a soil with low infiltration capacity, slow internal drainage and slopes between 2–3%. They were able to increase water storage and use efficiency. As a way to adapt to the climate change in years with the presence of the El Niño phenomenon, Cenicaña has been evaluating the practicality of using surface irrigation with very small furrow inflow rates to irrigate sugarcane.

Methodology

This system, referred to as furrow irrigation with low inflow rates, uses water diverted from small streams. Typically, low hydraulic heads (less than 10 m) are available to convey the water to the fields.. Cheap pipelines of 100 mm diameter, made of recycled polyethylene bags, are used to conduct the water at the low pressure heads to the fields. Water is applied to each furrow using plastic tubes of 6 to 16 mm in diameter. Water is applied by gravity using small furrow inflow rates in the range of 0.1 to 0.3 L/s. The conventional furrow irrigation practice of sugarcane on the flat areas uses inflow rates above 5 L/s. With the new system, furrow lengths of 100 to 120 m are typical, with slopes above 1%. The irrigation water advance phase is 20 to 24 hours, applying water

depths in the range of 100 to 130 mm. Water applied to the furrow inlets creates a kind of ponded zone in a distance of 2 to 3 m, and then it advances through the soil as horizontal infiltration and, after 20 to 24 hours of continual water supply, it reaches the end of the cane row. The slow application of water, using furrow inflow in the range of 0.1 to 0.3 L/s, results in a pronounced lateral movement of the water front. The water advance along the furrow length is controlled by gravity and by the presence of a coarser soil layer underneath the surface soil layer, which acts as a barrier to vertical water flow due to the high discontinuity in hydraulic conductivity between the surface and the underlying soil.

The system has been under evaluation at the foot hills of the Central mountain range in a farm (Vallecito) of Castilla sugar estate. The soil is considered as a Mollisol with skeletal clay textural family, and the field slope varies between 1.7 and 4.9%. The experiment followed a randomised complete block design with six water inflow rates (0.00, 0.06, 0.08, 0.10, 0.11 and 0.12 L/s) as treatments and four replications were established. The nearby field sprinkler irrigated and managed by the sugar estate was taken as a reference. The test cane variety was Co 421 planted by the sugar estate in this area.

Results and discussion

The hydraulic system to convey and deliver water to the cane was installed at the beginning of the fourth ratoon which was harvested at 11.5 months of age (Table 1). During the crop cycle, precipitation amounted to 1025 mm, and 1856 mm of evaporation occurred. Irrigation was applied according to Cenicaña's water balance calculations.. On average, five irrigation events were applied to the experimental area under reduced inflow rate application. The irrigation water depth varied between 205 and 956 mm. As a result of the non uniform slope of the furrows, in places where the furrow slope was higher, the water advanced faster, resulting in the applied water depth being smaller. The total amount of water received by the crop ranged from 1063 mm for the plots without irrigation up to 1981 mm for the treatment with inflow rates of 0.07 L/s. Cane yields within the plots irrigated with reduced inflow rates varied between 56 to 80 t/ha as compared with the sprinkler-irrigated field that yielded 56 t/ha with an applied irrigation depth of 70 mm for two irrigation events. It is necessary to recognise that, under the experimental area, there was high variability due to soil conditions and field slope that induced unexpected changes in water advance times, water advance velocity and total irrigation water depths.

Table 1 – Production results from the fourth ratoon crop of Co 421 variety in the experiment of reduced inflow rates at Castilla sugar estate.

Treatment	Flow rate (L/s)	Irrigation water depth (mm)	Total water received (mm)	TCH	Sucrose % cane
0			1063	56c	12.1
1	0.07	812	1837	56c	10.9
2	0.08	956	1981	75ab	10.6
3	0.11	602	1627	61bc	10.7
4	0.11	258	1283	80a	10.7
5	0.12	205	1230	59cb	11
Mean				64	11
CV%				17	5
Signific. %				2	NS

Conclusions

The results from this evaluation are very promising, and it can be concluded that the reduced inflow rate system of irrigation could be adjusted to match the local conditions of individual fields. It is expected to improve cane yield of commercial fields by adjusting water application rates and the fertiliser rates according to the content of gravel in the soil and the available soil water holding capacity. The system opens the possibility to use depleted surface water streams and use low cost

plastic pipes which make it attractive to be used in rural area to irrigate cash crops. The system has been under evaluation by Cenicaña in different parts of the foot hills of the Cauca river valley.

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L'IRRIGATION DE LA CANNE A SUCRE A TRES FAIBLE DEBIT DE RAIE

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Faible Débit, Coût Faible.**

Résumé

L'IRRIGATION de la canne à sucre par aspersion est une pratique courante au pied des collines de la vallée de la rivière Cauca de Colombie. Les coûts énergétiques limitent l'utilisation de ce système d'irrigation et d'autres moyens d'irrigation utilisant des petites sources de surface sont en cours d'évaluation. L'eau est appliquée par gravité avec des faibles débits de raie entre 0.1 et 0.3 L/s alors que l'irrigation à la raie sur des surfaces plates utilise des débits supérieurs à 5 L/s. L'eau est déviée des petits ruisseaux et conduite aux champs avec des faibles charges hydrauliques (moins de 10 m). Des raccords bon marché de 100 mm de diamètre, fabriqués avec des sacs de polyéthylène recyclé, sont utilisés pour conduire l'eau à basse pression aux champs où elle est appliquée aux sillons avec des tubes en plastic de 6 à 16 mm de diamètre. Les sillons de 100 à 120 m de long avec des pentes supérieures à 1% sont irrigués pendant la phase d'avancement en 20 à 24 heures appliquant des profondeurs d'eau dans la gamme de 100 à 130 mm. Des rendements canne de l'ordre de 84 t/ha, qui se comparent très bien à ceux des parcelles irriguées par aspersion ont été obtenus.

RIEGO DE LA CAÑA DE AZÚCAR CON MUY BAJOS CAUDALES POR SURCO

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Caña de Azúcar, Bajo Caudal, Bajo Costo.**

Resumen

EL RIEGO por aspersión de la caña de azúcar es una práctica común en los piedemontes del valle del río Cauca en Colombia. Los costos de la energía limitan el uso de este sistema y se están ensayando formas alternativas de riego usando pequeñas corrientes superficiales. El agua se aplica por gravedad usando pequeños caudales por surco entre 0.1 y 0.3 L/s mientras en el riego por surcos de la caña en las zonas planas se usan caudales por surco mayores a 5 L/s. El agua se deriva de pequeñas corrientes y se conduce a los campos usando pequeñas cabezas hidráulicas (menores de 10 m). Tuberías de bajo costo de 100 mm de diámetro, hechas de polietileno reciclado, se utilizan para conducir el agua a baja presión a los campos donde el agua es aplicada a los surcos usando tubos plásticos de 6 a 16 mm de diámetro. Longitudes de surco de 100 a 120 m con pendientes mayores del 1% se riegan en tiempos de avance de 20 a 24 horas aplicando láminas entre 100 y 120 mm. Se obtuvieron productividades de caña del orden de 84 t/ha, que compiten muy bien con la producción de las parcelas regadas por aspersión.