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ABSTRACT

Madiha Saber Ibrahim Ahmed Mira, studies on " Design and Manufacturing of an Injection Machine for Cotton-Stalk Under Soil Surface to Improve Its Properties " Unpublished Doctor of Philosophy, Ain Shams Uni. Ins. Of Environmental Studies and Research (2007).

The aim of this study is to design and test a machine to incorporate crop residues and conserve the environment. Four crop residue feeders were tested (cross fingers, cross claws, spiral fingers and spiral spoon auger), along with four feeder-speeds (20, 30, 40 and 50 rpm), three cotton stalk residue sizes (1, 3, 5 cm) and three furrow depths (20, 30 and 50 cm) .

The results of this study were summarized as following:

- The best feeder was spiral spoon at feeder speed of 50 rpm and residues size of 1 cm which gave residues discharge of 456 kg/h.

- At the case of 20 cm depth, with cotton residues incorporation, the mean values of the hydraulic conductivity, infiltration rate and bulk density were 65.50, 39.83, 18.64 cm/h and 77.50, 46.00, 19.80 cm /h and 0.92, 0.93 and 0.90 g/cm^3 for 45, 105 and 180 days from *alfalfa, (Berseem – Tirfolium SP).*

-The maximum penetration resistance was 85.4 N/ cm2 at soil depth 20 - 40 cm and crop residues furrow spacing of 1 m.

Meanwhile, the minimum penetration resistance was 58.6 N/ cm2 at soil depth 0 - 20 cm and crop residues furrow spacing of 3 m.

-The maximum ground-wheel slip of 4.5 % was obtained with forward speed of 3.6 km/h and soil depth of 50 cm. Meanwhile, the minimum ground-slip wheel of 1.9 % was obtained with forward speed of 1.5 km/h and soil depth of 20 cm.

- The maximum power of 63.49 kW (82.5 hp) was obtained with forward speed of 3.6 km/h and soil depth of 50 cm. Meanwhile, the minimum power of 32.49 kW (42.2 hp) was obtained with forward speed of 1.5 km/h and soil depth of 20 cm.

- The maximum performance of the designed machine of 3.26 fed./h was obtained with using forward speed of 3.6 km/h and residues furrow spacing of 7 m. Meanwhile, The minimum machine-performance of 0.53 fed/h was obtained with using forward speed of 1.5 km/h and residues furrow of 2 m.

- The maximum total alfalfa yield of 43.75 ton/fed was obtained with cotton residues depth of 20 cm. Meanwhile, the minimum yield of 35.8 ton/fed was obtained with depth of 50 cm.

- The increasing of net profit of using the crop residues incorporation machine (at 3-m mulch spacing, 20 mulch depth and 1.5 km/h forward speed) was 922.3 L.E./fed.

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Introduction

The amounts of plant residues in Egypt reach about 25.6 million ton / year, and the percentage used as energy with direct burning is about 9.91 million ton / year, when using primitive ovens with a low quality of lees more than 10 %. This presents a great loss in energy, in addition to its direct effect in environment pollution and public health hazard **El-Berry and Baiomy, 2005).**

On the other hand, storing residues in farms and on roofs of village houses, makes a favorable environment for insects, rats and disease carriers which affect people, animals and plants, in addition to the great possibility of destructive fire **(Abd El Mottaleb,1996).**

Burning stalks represents great loss in energy which is equivalent to nearly about one million ton of stalks (dry matter) with an approx. amount of 180.6 million L.E. / year. The amount of cotton-stalks reaches 1.39 million ton/year **(El-Berry and Baiomy, 2005).**

These residues are considered very important for the environmental and agricultural issues. The amount of stalks per fadden is approx. about 1.42 ton **(Awady et al.,** and **Mira, Madiha, 2001).**

The handling of harvest residues by traditional way increases pollution when burning in open space, and that doubles the costs of medical care and diseases' treatment which results from burning, in addition to great amount of dust when transporting these residues. Moreover, there are needs for fertilizers to cover lost nitrogen during traditional handling **(Abd El Mottaleb, 1996).**

The aim of the present work is designing, construction and testing of residues incorporation -machine into the soil, improving drainage and soil air circulation, recycling cotton residues into soil, and adding organic matter into soil to improve its capabilities .

2- REVIEW OF LITRATURE

2–1 Crop residues incorporation methods and machines.

Dawkins et al. (1984) found that in a field study, machine double digging to loosen the soil to a depth of 45 cm reduced soil strength and bulk density and increased air-filled pore space. Root development in peas in 1980 and the following wheat crop in 1981 was encouraged beyond the depth of loosening and resulted in increased water extraction compared to plots ploughed 23 cm deep in spring. Total bulk density of peas was not increased by machine double digging but was increased in a trial with manual loosening. Yield of green peas was reduced by machine or manual deep cultivation. Incorporation of P and K into the subsoil also decreased pea yields. No increase in wheat yield was found.

Patterson (1984) recommended that pretreatment of straw by tractor-drawn or combine-mounted choppers is judged to be essential for satisfactory incorporation, and cultivation should then involve 2 passes to mix and invert straw before drilling. The performance of existing equipment is reviewed for mixing and inversion and future developments in straw chopping and cultivation equipment.

Morita et al. (1984) studied the methods for mixing combine-discharged rice and barley straw in the soil layer of paddy fields by means of medium to small-sized tractors. Results obtained showed that it is essential to till and mix the crop as soon as possible after harvesting in order to hasten straw decomposition in the soil. Shallow flooding (1-2 cm deep) is recommended for puddling and also tractors worked at low speeds. When planting rice seedlings in paddy fields, where barley straw has been applied, the soil should be a little harder than in those fields without straw application and the surface water drained completely. The timeliness of crop harvesting is very important. The use of medium and small machines such as 22 hp (16 kW) tractor and a swath 1.35 m head-feeding combine reduced labour requirements and gave a total working time of about 6.6 h/10 acre for paddy rice and about 5.0 h/10 acre for barley. In the early stage, rice growth was somewhat inhibited by the application of straw to the soil, though such inhibition decreased with years. Production stability and yield can be increased by selecting appropriate rice varieties and by using effective manuring and water management. Straw application increased the soil fertility of paddy fields, considerably improving the growth and yield of barley and decreasing early ripening. Continued application of straw of paddy rice and barley improves the physical properties of soil, thus increasing the working efficiency of tillage. The workable area of field for a mechanized system of this scale, which is controlled by the working capacity of combine harvesters is 7-8 ha, that is, about 55-60% of 13 ha, the workable area of field for single cropping of paddy rice..

Konoval et al. (1985) found that the machine incorporates a herbicide sprayer, subsoilers, rotary cultivators, pneumatic drills and a roller. Herbicide is sprayed on the soil surface and the inter-row area is cultivated at a depth of 14-16 cm, while the rotary cultivators crumble the soil along the row to seed placement depth and simultaneously mix in herbicide before the seeds are drilled, covered and rolled. The prototype machine has a working width of 4.2 m and is of 6-row design. A work rate of up to 4 ha/h was achieved with a coefficient of variation for seed placement of <less or => 15%. Costs, labour requirement and fuel consumption were all substantially reduced.