The Effect of Adding Shallow Tines That Changeable Distance and Wings on the Field Performance of the Subsoiler Plow in Clay Soils

By

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Abstract

A subsoiler was designed and manufactured in mechanization Dept., Agric. College, Basrah University. The subsoiler consists of a frame and single tine. The tine was fixed on the frame with forward angle (rake angle) of 60°. The length, width and thickness of the leg are 95, 12 and 2 cm.

The subsoiler provided with foot fixed at the end of the leg with downward angle of 120° from the leg front edge. The front of the foot was cut at angle of 35° (attack angle). The foot was provided with wings. The wings width and inclination angle are 30 cm and 25°. The subsoiler was provided with two shallow tines. The shallow tines forward inclination angle is 65°. They were provided with foot only without wings. The foot dimensions and the forward inclination angle were the same of that of the subsoiler. The lateral distance between the shallow tines can be changed. Their depth is 75% of the subsoiler. The experiments were conducted using four subsoiler combinations namely; single subsoiler (S); subsoiler plus two shallow tines (S+sh) with three lateral distances (40, 50 and 60 cm); single subsoiler plus wings (SW); subsoiler plus wings and shallow tines (SW+sh). With lateral distances are (40, 50 and 60 cm).The experiments were conducted using four operating depths (30, 40, 50 and 60 cm).

The forward speed is 0.34 m/sec. The soil of the field of experiment was silty clay. The results showed the following:

1) The draft force and soil disturbed area increased as the operating depth increased. The increase in the draft force is between 13.75 to 36.07 kN for the subsoiler without wings

while is between 15.66 to 38.13 kN for with wings for operating depths of 30, 40, 50 and 60 cm.

The soil disturbed area the increase for the subsoiler without wings is between 0.107 and 0.422 m^2 while with wings is between 0.136 and 0.557m^2 for the same operating depth.

2) The draft force and soil disturbed area increased as the lateral distance between the shallow tines increase. The increase in draft force is between 15.19 t0 36.07 kN and 17.55 to 38.13 kN for without and with wings respectively. The increase in the disturbed area is between 0.123 to 0.422 m^2 and 0.145 to 0.557 m^2 without and with wings respectively. The highest disturbed area (0.557m^2) was recorded for operating depth of 60 cm for (SW) and the shallow tines at lateral distance of 60 cm.

3) The specific resistance decreased as the operating depth increased. The decrease is between 128.50 to 85.45 kNm^{-2} and 115.14 to 68.38 kNm^{-2} without and with wings respectively. The lowest specific resistance was recorded for operating depth of 60 cm, with shallow tines at 60 cm a part and with wings.

4) The specific resistance decreased as the distance between the shallow tines increased. The amount of decrease for the distance 40, 50 and 60 cm is between 123.49, 85.45 kN/m^2 and 119.98 to 68.38 kNm^{-2}. Without and with wings respectively. The lowest specific resistance (68.38 kNm^{-2}) was recorded for operating depth of 60 cm, lateral distance of 60 cm and with wings.

5) The energy utilization efficiency increased as the operating depth increase. The increase in the efficiency is between 7.78 to 11.70 m^3MJ^{-1} for the subsoiler without wings while is between 8.68 to 14.62 m^3MJ^{-1} for with wings operating depths of 30, 40, 50 and 60 cm.

The highest efficiency (14.62 m^3MJ^{-1}) was recorded for operating depth of 60 cm for (SW) and the shallow tines at lateral distance of 60 cm.

6) The energy utilization efficiency increased as the distance between the shallow tines increased. The amount of increase for the distances of 40, 50 and 60 cm is between 8.09

to 11.70 and 8.38 to 14.62 m^3MJ^{-1} without and with wings respectively. The highest energy utilization efficiency (14.62 m^3MJ^{-1}) was recorded for operating depth of 60 cm, lateral distance of 60 cm and with wings.