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UTILIZATION OF MODIFIED AIR-BLAST SPRAYER FOR WEED CONTROL

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ABSTRACT

Using the flame in weed control is the most important alternative that means least harmful to environment and alternative to use of herbicides. Therefore, the main aim of this study was investigating the possibility using diesel fuel in weed control by developing and modifying the air-blast sprayers that it was investigated to killed and removed weeds in and aside irrigation and drainage filed ditches and also around fruit trees. This is done by installing a unit to generate the flame at the end of the air exit hole with replacing the pesticide inside the tank with diesel fuel. The experiments were conducted at the El-Serw Agricultural Research Station in 2013. The theoretical study was identified to determine the appropriate burning rate to singe, intensity and effect of flame out distance from device. The fuel diesel amount, fuel consumption and field capacity were estimated under flame speed of 1.6, 2.0 and 2.4 km/h; air velocity of 44, 57, 68 and 83 m/s and nozzles diameters of 0.75, 1.00 and 1.25 mm. The modified flame device evaluated measuring the flame length, completely flamed weeds ratio per m^2. The fuel diesel for weeds controlling was estimated and fuel consumed and then the field capacity. The results indicated that using the modified flame device to burn weeds in and aside irrigation and drainage filed channels at the operating forward speed of 1.6 km/h, and air-blast speed of 83 m/s with nozzle diameter of 1.0 mm achieved a long effective flame length of 92 cm, weeds burning rate, directly after treatments, of 95 % and burning weeds rate 8 hours later, of 100 %. Field capacity was 1407 m^2/h and diesel consumed for flaming 5.5 l/1000m^2 under the same previous conditions respectively. The study recommended that using the developed device in and aside irrigation and drainage filed channels and around fruit trees. Furthermore, it can be used in small holdings with possibility of developing the device to become self-propelled for use in large spaces.

INTRODUCTION

The risk for pollution of the environment and drinking water reservoirs has led to several restrictions on the use of herbicides for weed control in areas which increase the need for alternative control methods (Lefevre *et al.*, 2001; Hansson, 2002; Augustin, 2003; Kristoffersen *et al.*, 2004). Using fire to control weeds in organic farming systems shows promise for reducing weed populations without herbicides (Mutch, *et al.*, 2005). Flaming disrupts weed growth through heat, so it is important to flame when the plants are dry and wind speed and direction are favorable. Both moisture and wind can lower the heat from the flame, reducing the effectiveness of the flaming application. Exposing a weed seedling to flame for 1/10 of a second is usually enough to ensure control, although this may vary with weed type and size (www.flameengineering.com). The energy dose applied by weed control machinery is mainly regulated by the driving speed (Ascard, 1995b; Hansson, 2002). A combination of driving speed and length of equipment determines the treatment time. The driving speed is usually quite low to achieve sufficient thermal weed control and reduce weed re-growth and thereby the treatment time and costs are increased. Weeds are most susceptible to flame heat when they are 1 to 2 inches tall or in the three- to five-leaf stage (Sullivan, 2001). Broadleaf weeds are more susceptible to flaming than grasses such as foxtail. For many grasses, the growing point is below the soil surface where the flame's heat cannot penetrate effectively to stop or suppress growth.

Thermal control methods can be divided in two groups according to their mode of action (a) the direct heating methods (flaming, infrared welders, hot water, steaming, hot air) and (b) indirect heating methods (electrocution, microwaves, laser radiation, UV-light), with freezing as a third and opposite plant stress factor. Several studies aiming to improve agricultural weed control have shown the importance of the developmental stage of the weed plants at treatment (Parish, 1989 and 1990; Casini *et al.*, 1993; Ascard, 1994, 1998; Hansson & Ascard, 2002). Treatment at an early developmental stage reduced fuel input and thereby increased driving speed and lowered the costs. Ascard (1994) found weed density to be of minor importance in flame weeding. Variable response of weeds to flaming is species dependent with broad leafed weeds being more sensitive than grasses and species with unprotected growing points more sensitive than those with protected growing points (Ascard, 1995). Also he added at (1994) that plant size had greater influence upon sensitivity than did plant density, with small weeds being more sensitive than large weeds.

Guerena (2012) reported that utilize of propane flamers to reduce the options for other forms of weed control. This technique is effective on small, recently germinated broadleaf weeds. In parks, small 5 gallon propane tanks are used to control weeds around tree wells or between cracks. The amount of surplus air may range from 30% to 70% in some applications, and by controlling the amount of air down to the required quantity, and high degree of precision, control good operational conditions as there are many indicators that help to get the process done (flame length and color, presence of smolder, etc.), and practically in modern designs 25% excess air to fuel gas, 40% excess air for fuel oil is used (Gamaly, 1981 in Arabic).

Irrigation and drainage canals weeds are one of the major problems for consumed much water and hinders water movement. Organic weed control producers rely extensively on mechanical and hand weeding. The high aquatic weed infestations caused a lot of problems such as water losses, retardation of flow, obstruction of gates and intakes, interference with navigation, health hazards and alteration in the physic-chemical characteristics of both water and hydro soil (Tarek *et al.*, 2009). The Egyptian canals and drains are infested by aquatic weeds and their degree of infestation are affected by environmental factors, including water transparency, water depth, physicochemical water quality, water currents and air temperature (El-Gharably *et al.*, 1982).The labour cost for hand control weeding is expensive (e.g., ranging from 200 to 300 LE/feddan), time consuming and could be difficult to organize due to time constrains. Hence, making better use of alternative weed management tactics need to be developed.

Therefore, the objectives of this paper were to determine theoretically the amount of air to burn one kg of diesel fuel per mass and to determine the air pump speed. Practically, to identify the flame length and speed flamed weeds control efficiency, the fuel consumption, the diesel amount for burning weeds and the field capacity. Finally, to carry out the statistical analysis and compared the final data.

THEORETICAL CONSIDERATIONS

This part includes the necessary calculations to figure out the amount of air (m^3/h) that, confirms complete combustion of diesel fuel and push fire in concentrate flow outside the combustion tube. If these values are recommended, then it easy to adjust the fan capacity by accelerating the air which give the appropriate amount.

Calculate the theoretical air amount

Regarding to table (1), the diesel fuel components ratios consists of 86.3% Carbon, 12.8% Hydrogen and 0.9% Sulphur by mass. The calorific value (kJ/kg) and thermal value (kJ/kg) are 45971 and 44570. Also, molecular weight, the number of moles and amount of oxygen required to burn one kg of diesel fuel are illustrated in tables (2) and (3).

To perform the calculations according to burn one kg of diesel fuel per unit mass and net volume a simple relation was conducted by multiplying mass of constant kg/kg fuel (table -1) in Oxygen ratio per kg (table-3). Then the results were:-

The O_2 required kg/kg fuel for Carbon = 0.863×2.666 =2.301;

The O_2 required kg/kg fuel for Hydrogen = 0.128×8 =1.024;

The O_2 required kg/kg fuel for Sulphur = 0.009×1 = 0.009

Then the Total O_2 required = 2.3 + 1.024 + 0.009 = 3.334 kg/kg fuel

Table (1): Diesel fuel and set specifications for components ratios (Gamaly, 1981 in Arabic).

Diesel fuel				
Compositions by mass	C	H	S	Specific gravity
	86.3	12.8	0.9	0.87
Gross calorific value in kJ/kg	Higher			Lower
	45971			43166
Thermal value, kJ/kg	Total			Net
	44570			41900

Table (2): The molecular weight and the number of moles

Substance	Atom		Molecule	
	Symbol	Atomic mass	Symbol	Molecular mass
Carbon	C	12	C	12
Hydrogen	H	1	H_2	2
Sulphur	S	32	S	32

Table (3): The amount of oxygen required to burn (Gamaly, 1981 in Arabic)

Substance	Oxygen red in (kg)	Oxygen red in (m^3)
C	2.666	1
H_2	8	1/2
S	1	1

Regarding to air density is 1.204 kg/m^3 and density of diesel is 870 kg/m^3, then the size of one kilogram of diesel fuel is 1.149 L, so the theoretical amount of air required to burn one liter of diesel is 11.935 m^3. Then,

Air required = 3.334/0.232 = 14.37 kg of air
= 11.935 m^3 of air

Usually diesel fuel needs amount of combustion air more than the theoretical quantity necessary for combustion to ensure that all mixing fuel with oxygen molecules and a full ignition. The amount of surplus air may range from 30% to 70% in some applications, and by controlling the amount of air down to the required quantity, and high degree of precision, control good operational conditions as there are many indicators that help get the process done (flame length, and flame color, and the presence of smoke, etc.), and practically in modern designs 25% excess air to fuel gas, 40% excess air for fuel oil is used (Gamaly, 1981 in Arabic). The actual amount of air required to burn one liter of diesel fuel is: -

So, the actual amount of air required to burn one liter of diesel fuel is:

Air required =11.935 + 4.774 = 16.609 m^3 air

Then the quantity of air required for the disposal of different rates can be shown in figure (1).

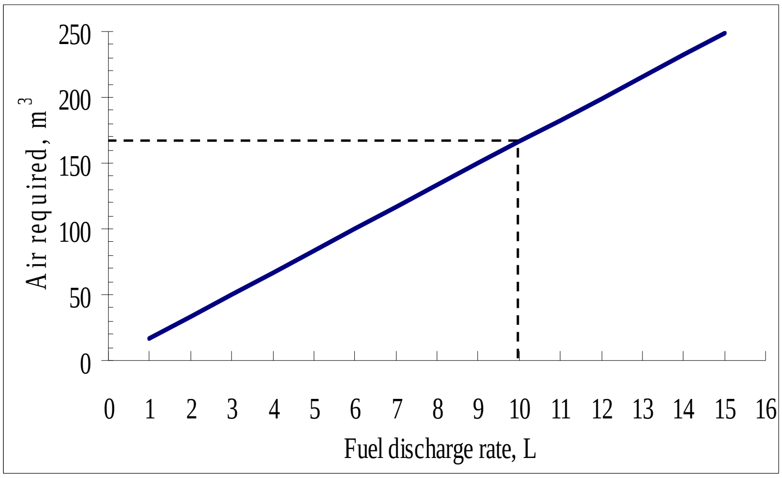


Fig. 1: The quantity of air required for the disposal of different rates

By measuring the average rates of fuel discharge from flame generating unit under experiment operating conditions and substituting in fig. 1 can be define the requirement. In experimental field the fuel discharge rate were 6.5; 7.75 and 9.0 L/h.

Referring to Fig.1 and for example at fuel discharge rate of 10 L/h the required air obtained about 166 m^3. disposal and combustion.

Determine the air pump speed

The air pump of sprayer gives 640 m^3/h under rotational speed of 6000 rev/min and it can be through applying geometric symmetry to obtain rotational speed which gives the required rates are as follows:- (Singh and Heldman, 1984)

$$\frac{Q_1}{Q_2} = \frac{N_1}{N_2}$$

$$\frac{640}{150} = \frac{6000}{N_2}$$

$$N_2 = 1406.25 rpm$$

Then, the optimum air pump revolution can be regulating more than the 1406.25 rpm. And can obtain the new speed by adjusting the fuel stick with the four levels to give proper air act to ensure good combustion.

MATERIALS AND METHODS

Field experiments were carried out at El-Serw Agricultural Research Station using an ordinary flame device that mounted on the back. The specifications as shown in table (4) was used in this paper to control of herbs and weeds or all grass in irrigation and drainage canals. The main idea of flame device is depending on evaporating the diesel fuel that out from nozzle which combusts making a flame and by push fire in concentrate flow directly forwards to weeds and herbs it killed weeds.

Diesel fuel was used as a safer material, not dangerous and disasters, easy controlling flame size and length. The modified flame device easy used in all withers conditions as wind and humidity.

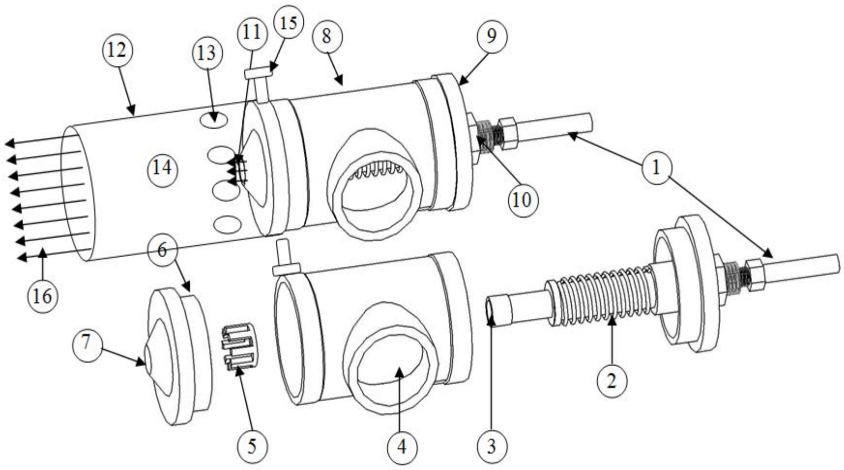
Table 4: Specifications of the used modified flame device

Item	Specifications	Item	Specifications
Engine	2 strokes, air cooling, single cylinder, with gasoline	Air flow (m^3/h)	640
Cylinder Volume (cc)	70	Air velocity (m/sec.)	100
Rotation (rpm)	6000	Fuel consumption (g/hp.h)	425
Power (hp)	5.0 (SAE)	Fuel tank (lt.)	1.8
Carburetor	Float/Diaphragm	Chemical liquid tank (lt.)	20
Ignition	Electronic	Package Dimensions (W x L x H) cm	35x50x78
Running starter	Automatic sprung starter	Weight net (kg)	15.5

Modifications of the flame device

- Replacing the plastic tube which transfers air-blast with a metal one avoiding heat transfer from the flame device to the plastic tube (figure-2.)
- Changing the plastic cone end and the nozzle with a metal nozzle 1.0 mm (Fig. 3).
- The modification included fixing a flame ejector unit (figure 3) at the end of air-blast tube.
- Fixing a burner shield with holes to support the flame with the oxygen needed for combusting to the last extent. (Fig. 4)

Figure 2: The ejector with a nozzle of 1.0 mm



1- Diesel fuel hose (inlet) 2- Adjusting zipper 3- Diesel fuel nozzle (outlet)
4- Impulsive air inlet 5- Air distributor 6- Adjusting clearance nut
7- Cone burner (burner head) 8- Burner's body 9- Copper joints nut
10- Adjusting nut 11- Primary ignited air intake 12- Burner shield
13- Secondary ignited air intake 14- Adequate mixing of air and vapor diesel
15- Holding screw 16- Flame

Fig. 3: A schematic diagram of the diesel burner weed control

Fig. 4: The developed burner during using in the field

In flame weeding, a diesel-fueled torch shoots a flame at the targeted weeds. The flame can reach a temperature of up to 2500°F much hotter than is required to denature plant proteins. At 212°F water in the plant boils, expands, and breaks cell walls. As moisture leaks out from the plant, it wilts and eventually dies. Because of its high specific heat, water vapor as a combustion product tends to lower the flame temperature of hydrogen containing compounds. The endothermic dissociation of water at high temperatures above 2000°C also prevents flame temperatures to rise above 3000 to 4000°C.

Treatments

1- Three nozzle diameters of 0.75, 1.0 and 1.25 mm. (represent flow rate of 6.5, 7.75 and 9.0 L/h) for combustion were calibrated before the test and determine the mark for every level.
2- Four the duct air velocity of 44, 57, 68 and 83 m/s were determined using the air meter device.
3- Three operating speed of 1.6, 2.0 and 2.4 km/h which represent three times exposure per square meter of 10, 7 and 5 sec, respectively.

There were three replicates for all parameters under study which were arranged in a split-split plot design.

Measurements

1- Flame length, m: It was measures by using a metal scale.
2- Completely flamed weeds ratio. Completely flamed weeds ratio in m^2 directly and 8 hours after flaming for the large and small weeds were determined using the square wooden frame.
3- Fuel consumption. It was determined by measuring the volume of fuel consumed during the operation time for each run and calculated in liter per hour. It was measured by completely filling the fuel tank then before each end run refilling the fuel tank using a scaled container.
4- Spent diesel for burning weeds
5- Field capacity m^2/h (*AFC*) measured using the following equation:

$$AFC = \frac{1}{ATT} \quad m^2/h$$

Where: *ATT* is the actual total time required per burning m^2/h.

6- Regression analysis. Microsoft Excel 2007 computer program was used to carry out the multiple regression analysis to represent the effect of the modified flame device operating forward speed and the air velocity on flame weeds ratio, fuel consumption, spent diesel for burning weeds and field capacity.

RESULTS AND DISCUSSION

1- The flame length

The effect of air-blast velocity and nozzle diameters under tube burner shield on flame length, cm is shown on figure 5. It is clear that increasing air-blast velocity resulted in increasing flame length. Increasing air-blast velocity from 44 to 83 m/s resulted in increasing flame length from 45 to 86 cm. These results were under nozzle diameter of 0.75 mm. similar trend was shown with medium values of air-blast velocity which showed flame length of 62 and 77 cm for 57 and 68 m/s air velocity, respectively.

On the other hand increasing nozzle diameters resulted in increasing flame length. The flame length was 86, 92 and 105 cm under nozzle diameters of 0.75, 1.0 and 1.25 mm, respectively. These results were under air-blast velocity of 83 m/s. similar results were obtained under air velocity of 44, 57 and 68 m/s. The previous results may be due to the increase of air-blast velocity that increased the amount of oxygen needed for flaming and consequently increased the flame length. Also, increasing air-blast velocity resulted in increasing the diesel diffusion which enhancing it's flaming.

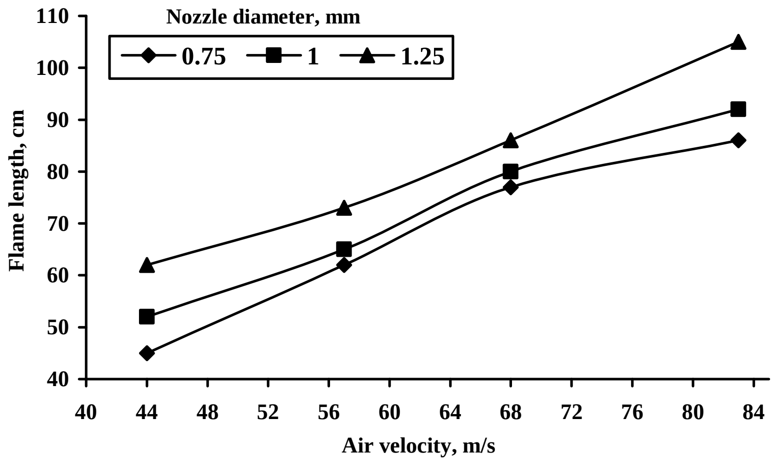


Fig. 5: Effect of air velocity on flame length at different nozzles diameters.

From the obtained results it was found that the nozzle diameter gave the tallest flame length of approximately 105 cm. It was obvious that testing nozzle diameter of 1.0 mm with increasing air velocity from 44 or 57 to 68 or 83 m/s substituted the sufficient amount of diesel used for flaming weeds. Therefore, all treatments were tested under using nozzle diameter of 1.0 mm which showed desirable results of flame length and saving diesel used for flaming weeds which appears throughout discussing the obtained data.

As the nozzle diameter of 1.0 mm showed desirable results for both flaming and consuming diesel used for flaming, it was chosen to represent the best nozzle diameter for preceding the other treatments.

2- The flamed weeds control

2-1: Directly after weeding

The effect of operating forward speed and air velocity on flamed weeds directly after burning is shown on figure (6). On the mentioned figure, increasing operating forward speed resulted in decreasing the flamed weeds directly after burning. Also, under air velocity of 44 m/s, increasing operating forward speed from 1.6 to 2.0 and to 2.4 km/h resulted in decreasing the flamed weeds from 87 to 85 and from 85 to 80 % respectively. The similar results were obtained under other air velocities. The increase of operating forward speed resulted in decreasing the time needed for exposuring the weeds to the flame which decreasing the flamed weeds. Notwithstanding, for acceptable results with all treatments, the operating forward speed of 1.6 showed the best results as it allowed to gave a sufficient time for exposuring the weeds for flaming that increased the flamed weeds.

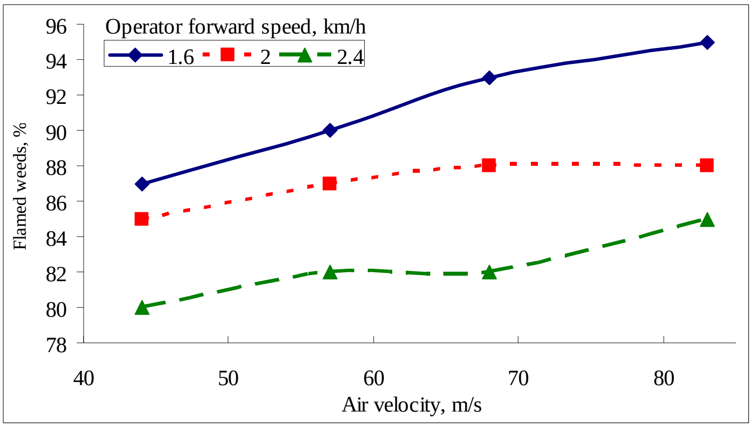


Fig. 6: Effect of air velocity on flamed weeds directly after burning at different operating forward speed and

2-2: Eight hours later burning

As discussed previously with flamed weeds directly after burning, the flamed weeds ranged from to 87 to 95% and the residuals ranged from 5 to 13 % under the different parameters. These ratios of 5 to 13% were observed after 8 hours from flaming. From the obtained data which shown on figure 7, it is obvious that increasing operating forward speed from 1.6 to 2.4 km/h resulted in decreasing flamed weeds from 90 to 80%. Operating forward speed of 2 km/h gave medium value. These results were under air-blast velocity of 44 m/s. increasing air-blast velocity to 68 and 83 m/s resulted in flamed weeds of 100 % with operating forward speed of 1.6 km/h. Generally, it could be concluded that after 8 hours from burning with operating forward speed of 1.6 km/h completely burning all weeds under treatments.

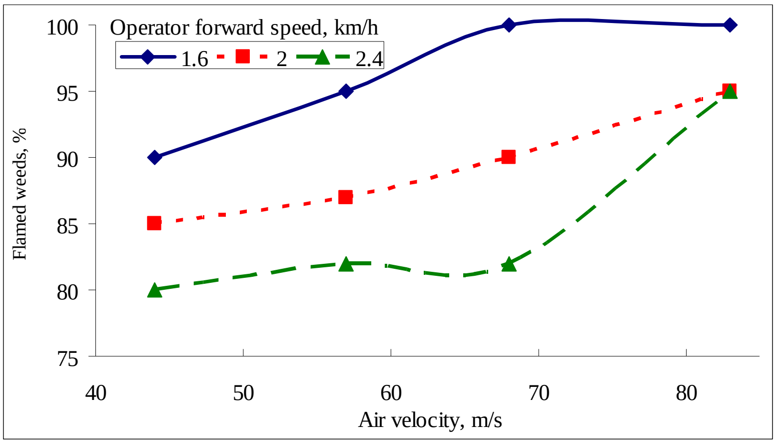


Fig. 7: Effect of air velocity on flamed weeds at eight hours later burning at different operating forward speed.

3- The fuel consumption

From figure (8), it is clear that decreasing operator forward speed (km/h) resulted in increasing fuel consumption (L/h). Decreasing operator forward speed from 2.4 to 1.6 resulted in increasing fuel consumption from 7.7 to 11.56 L/h under air-blast velocity of 44 m/s. From analyzed data there was a significant effect on fuel consumption (L/h) with operator operating forward speed (km/h). Although fuel consumption decreased under operating forward speed of 2.4 km/h and the flamed weeds ratio decreased. On the other hand, increasing air-blast velocity from 44 to 57 m/s resulted in decreasing fuel consumption from 11.56 to 9.48 l/h under operating forward speed of 1.6 km/h. Also, the fuel consumption was 9.48, 8.14 and 7.21 L/h for air-blast velocity of 57, 68 and 83 m/s, respectively. Similar trends were shown with operating forward speed of 2 and 2.4 km/h. Air velocity of 83 m/s with operating forward speed of 1.6 km/h gave the least fuel consumption of 7.21 L/h under tube-shielded burner which also gave the best results with flamed weeds under the same conditions.

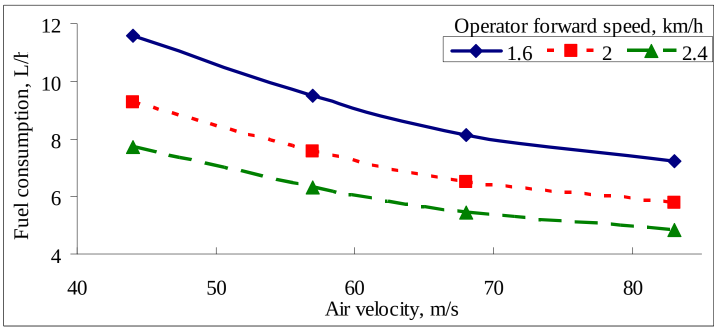


Fig. 8: Effect of air velocity on fuel consumption at different operating forward speed

4- The diesel amount for burning weeds

According to the obtained data and from Fig. (9) it is obvious that increasing operator speed km/h resulted in decreasing the diesel amount for burning weeds $L/10^3m^2$. Under operator operating forward speed of 1.6, 2 and 2.4 km/h resulted in decreasing the diesel amount which was 8.82, 7.06 and 5.78 $L/10^3m^2$, respectively. These results were under air velocity of 44 m/s. In the same way increasing air velocity m/s resulted in decreasing the diesel amount for burning weeds. Under air-blast velocity 44, 57, 68 and 83 m/s the diesel amount consumed for burning weeds was 5.87, 4.8, 4.14 and 3.67 $L/10^3m^2$., respectively. These results were under operator operating forward speed 2.4 km/h. While under operating forward speed of 2.0 km/h the consumed diesel was 7.06, 5.78, 4.97 and 4.4 $L/10^3m^2$. under the same conditions of air velocity. Similar trend was appeared with operating forward speed of 1.6 km/h. It was found that increasing air velocity could increase the flame length and heat so the operating forward speed was increased to lessen the consumed diesel for burning.

5- The field capacity

The effect of operating forward speed (km/h) and air velocity on field capacity (m^2/h) is shown on figure (10). From obtained data increasing operator operating forward speed resulted in increasing field capacity (m^2/h). Under the chosen parameters that showed acceptable results for flamed weeds (%) the field capacity of 877.8; 1096.2 and 1318.8 m^2/h for 1.6, 2.0 and 2.4 km/h operating forward speed respectively at air velocity of 44 m/s. The same trend was shown under other air velocities. Using air velocity of 83 m/s and operating forward speed of 1.6 km/h, gave the best results for flamed weeds in all treatments. Under these conditions, the field capacity was 1407 m^2/h. It means that one 4200 m^2 needed approximately three hours for flaming weeds.

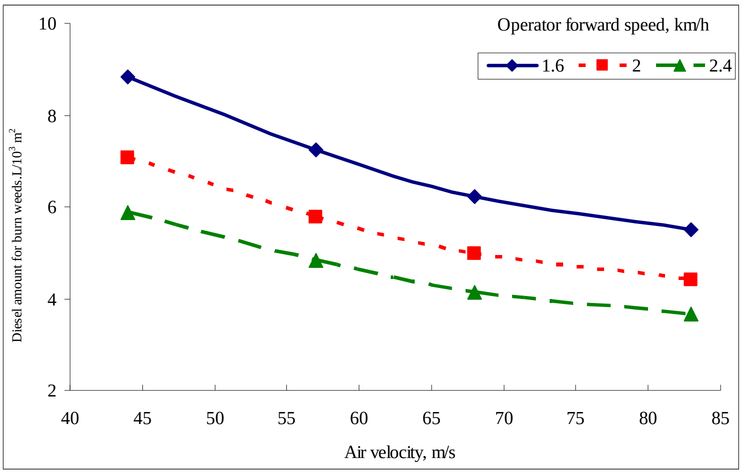


Fig. 9: Effect of air velocity on diesel amount for burning weeds at different operating forward speed

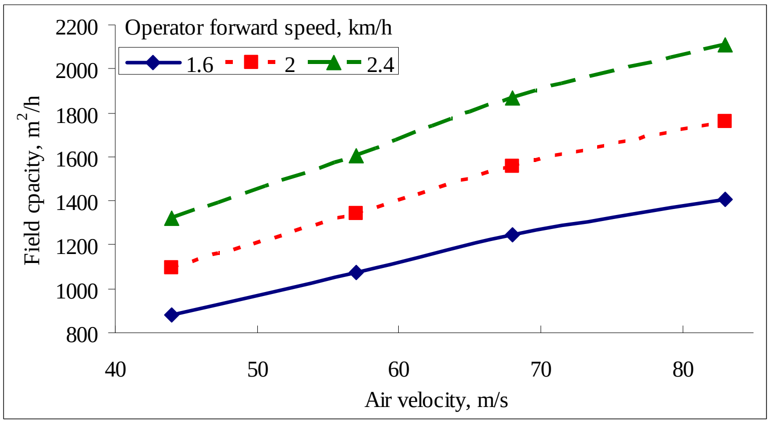


Fig. 10: Effect of air velocity on field capacity at different operating forward speed.

6- The regression analysis

The statistical analysis showed that the modified flame device recorded the highly significant difference in the flame weeds ratio, fuel consumption, spent diesel for burning weeds and field capacity due to the interaction of the operating forward speed and the air velocity. The regression analysis indicated that the relation between the flame weeds ratio (Y1 and Y2), fuel consumption (Y3), spent diesel for burning weeds (Y4) and field capacity (Y5) and the operating forward speed (S) and the air velocity (A) could be represented as follows:

Y1 = 100.83 – 11.25 S + 0.135 A (R^2 = 0.951) direct after burn
Y2 = 100.16 – 14.38 S + 0.296 A (R^2 = 0.896) 8 hours later burn
Y3 = 20.839 – 3.791 S - 0.092 A (R^2 = 0.955)
Y4 = 82.734 – 15.05 S - 0.364 A (R^2 = 0.955)
Y5 = 1076.4 - 717.94 S – 17.122 A (R^2 = 0.982)

From the regression analysis, it can be noticed that, there is a significant negative correlation between the operating forward speed and air velocity and the all measurements except the relation between flame weeds ratio.

CONCLUSION

There are many benefits to apply flame to weed control for irrigation and drainage canals. Optimal weed control often requires multiple flame applications, with little or no residual weed control effects. Flame applications must be timed precisely to kill weeds effectively. The results indicated that the possibility of using the modified flame device to burn weeds in and aside irrigation and drainage canals at the operating forward speed of 1.6 km/h, diesel fuel of 5.5 $L/10^3 m^2$, and air speed of 68 m/s, nozzle diameter of 1.0 mm so as to get a long the flame length of 92 cm, weeds rate directly after burn of 95 % and weeds rate 8 hours later burn of 100 % respectively. So, the possibility to recommend that, it can use the modified device in waterways for irrigation and drainage to eliminate the surrounding grass and also can be used in small spaces with the possibility of developing a device to become self-propelled for use in large spaces.

REFERENCES

Ascard J. (1994). Dose response models for flame weeding in relation to plant size and density. Weed Research 34, 377–385.

Ascard J. (1995a). Effects of flame weeding on weed species at different developmental stages. Weed Research 35, 397–411.

Ascard J. (1995b). Thermal weed control by flaming: Biological and technical aspects. PhD thesis. Department of Agricultural Engineering, Swedish University of Agricultural Sciences. Alnarp, Sweden. Report 200.

Ascard J. (1998). Comparison of flaming and infrared radiation techniques for thermal weed control. Weed Res. 38, 69–76.

Augustin B. (2003). Economic aspects of different methods of weed control in urban areas. In: Second International Symposium on Plant Health in Urban Horticulture (eds H Balder, KH Strauch & GF Backhaus), 155–165.

Casini P., P. Calamai and V. Vecchio (1993) Flame weeding research in Italy. In: Communications 4th International Conference IFOAM, Non-chemical Weed Control (ed. JM Thomas), 119–125. Association Colleque IFOAM, Dijon, France.

El-Gharably Z., A. F. Khattab and F. A. A. Dubbers (1982). Experience with grass carps for the control of aquatic weeds in irrigation canals in Egypt. Proc. 2nd Int. Symp. on Herbivorous Fish. EWRS Wageningen the Netherlands, pp: 1 7-26.

Guerena, M. (2012). City of Davis Integrated Pest Management Program 2012 Annual Report of Pesticide Use Page 2 of 22.

Hansson D. and J. Ascard (2002). Hot water weed control as influenced by developmental stage and time of assessment. Weed Research, 42, 307–316.

Hansson D. (2002). Hot water weed control on hard surface areas. PhD thesis. Department of Agricultural Engineering, Swedish University of Agricultural Sciences. Alnarp, Sweden. Report 323.

Kristoffersen P., S. U. Larsen, J. Møller and T. Hels (2004). Factors affecting the phase-out of pesticide use in public areas in Denmark. Pest Management Science 60, 605–612.

Lefevre L., P. Blanchet and G. Angoujard (2001). Non-chemical weed control in urban areas. In: The British Crop Protection Council Conference: Weeds 2001 (ed. CR Riches), 709–714.British Crop Protection Council, Farnham, UK.

Mutch A. R., A. T. Simon, E. M. Todd, and G. B. Dean (2005). Flaming as a method of weed control in organic farming systems. Michigan State University Extension Bulletin E-3038 New January.

Parish S. (1989). Investigations into thermal techniques for weed control. In: Proceedings of the 11th International

Parish S. (1990). A Review of Non-Chemical Weed Control Techniques. Biological Agriculture and Horticulture 7,117–137.

Singh R.P. and D.R. Heldman (1984). Introduction to food engineering. Academic press. Inc.

Sullivan P. (2001). Flame weeding for agronomic crops. ATTRA publication #CT157. URL: http:// attra. ncat.org /attra-pub /PDF/ flameweed. pdf. Retrieved March 2007.

Tarek A. E.. and M. A. E. Salwa (2009). Aquatic weeds monitoring and associated problems in Egyptian channels. Thirteenth International Water Technology Conference, 13 2009, Hurghada, Egypt.

www.flameengineering.com/Row Crop Flaming Practices and Techniques. Red Dragon Agricultural Flaming Guide. URL: http:// Agricultural_ Flaming_ Guide. html#practices. Retrieved March 2007.

د.جابر شنشول جمالي، ١٩٨١: تكنولوجيا الوقود. الجامعة التكنولوجية – مقرر الصف الثاني – هندسة كيمياوية، طبع بمطابع مؤسسة دار الكتب والنشر جامعة الموصل ١٩٨١ .

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يعتبر استخدام اللهب في مقاومة الحشائش من أهم الوسائل البديلة لاستخدام مبيدات الحشائش. لذا أجريت المحاولة لتطوير (رشاش الدفع الهوائي " موتور الظهر " Air-blast Sprayer) والذي يولد تيارا هوائيا كحامل للمبيد إلى قاذف لهب حيث تم استبدال المبيد داخل الخزان بوقود الديزل (السولار) وتركيب (وحدة توليد اللهب) عند نهاية فتحة خروج الهواء ومن ثم حمل اللهب لمسافة كافية عن طريق التحكم في سرعة وكمية الهواء الخارج من مضخة توليد الهواء وكذا التحكم في حجم اللهب وشدته من خلال تغير معدلات التغذية لوقود الاحتراق عن طريق استخدام عدد من الفواني المختلفة الأقطار لتوليد لهب قوي قادر علي حرق حشائش قنوات الري والصرف داخل حقول المحاصيل الحقلية. وقد أجريت هذه التجربة في محطة البحوث الزراعية بالسرو في الموسم الزراعي ٢٠١٣ حيث تم اختبار التطوير المقترح عند ثلاث سرعات تقدم لحامل الآلة (١.٦ ، ٢ ، ٢.٤ كم/ساعة) ومعدلات تغذية مختلفة لوقود الحرق وذلك من خلال ثلاث فواني مختلفة الأقطار (٠.٧٥ ، ١.٠٠ ، ١.٢٥ مم) مع أربع سرعات لهواء المضخة(٤ ، ٥٧ ، ٦٨ ، ٨٣ م/ث) والتي تؤثر على امتداد اللهب وتم اختبار هذه المتغيرات وتحليلها إحصائياً فكانت النتائج كما يلي:

كان أفضل امتداد للهب في حدود ٩٢ سم عند قطر فتحة للفونية ١مم مع سرعة هواء ٨٣ م/ث. كما كان أفضل حرق للحشائش عند سرعة تقدم ١.٦ كم/ساعة بنسبة مقدارها ٩٥% وكانت السعة الحقلية ١٤٠٧ م^{2}/ساعة وكمية الوقود المستهلكة لحرق الحشائش ٥.٥ لتر/ألف متر مربع تحت نفس الظروف السابقة. يوصى باستخدام الحرق باللهب كبديل لمقاومة حشائش قنوات الري والصرف داخل حقول المحاصيل الحقلية، مع إمكانية إستخدامها للقضاء على الحشائش التى تنمو حول أشجار الحاصلات البستانية وكذلك يمكن تطويرها لتصبح ذاتية الحركة لإستخدامها في المساحات الكبيرة.

قام بتحكيم البحث

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