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Rice Transplanting Weed Control Using Paper Mulching Technique

El-Metwally, W. F.*; M. E. El-Iraqi; M. A. M. El-Esaily and I. F. Sayed

Agricultural Engineering Research Institute (AEnRI), ARC, P. O. Box 256, Giza, Egypt

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ABSTRACT

The main objective of this study is using the mulching rice technique with degradable materials (paper) as an environmentally friendly method to suppress rice weeds in transplanting rice fields without using any contaminating herbicides. This experiment was done using three different colors of degradable mulching papers (White, Gray, and Brown), each color with two different masses (120 and 180 g/m^2) were used as mulching paper materials to cover experimental plots, compared with the uncovered plot with using herbicide treatment and control treatment of uncovered plot without using any herbicide. The obtained results revealed that using rice mulch paper was found to be very effective in weed suppression. Using any given color of mulching paper (180 g/m^2) give the highest value of weeding efficiency (100%) and highest useful life period (90 days) of mulching paper, compared with (95.97%) and (90 days) for mulching paper of 120 g/m^2. While the herbicide treatment gave the lowest value of weeding efficiency (76%). The values of dehydrogenase enzyme activity and the related total amounts of nitrogen (N); potassium (K), and phosphorus (P) were increased from 1st stage to 2nd stage and from 2nd stage to 3rd stage and then decreased from 3rd stage to 4th stage again for any given study parameters. The mulching treatment of covered plot with paper gray, 120 g/m^2 produced the highest value of grain and straw yield of 5.265 and 6.696 ton/fed., respectively, and gave the best results of grain quality.

Keywords: rice transplanting, mulching paper, soil microbial, dehydrogenase enzyme

INTRODUCTION

Rice is one of the most important food crops in the world, and it is considered the main staple food and plays a critical role in contributing to food security, income generation, and socioeconomic growth for many people in Egypt. However, weeds are a major limiting factor for the growth and yield of rice plants and cause 23 -100% reductions in grain yield/h, wastage of resources and human energy, and also pose health hazards to human beings. This is why several researchers are going to apply the Ground Cover (Mulching) Rice Production System for suppressing rice weed and improving the existing water saving due to less transpiration by the weeds.

Mulch is a layer of organic/inorganic material applied to the soil surface during growth of crop plants to realize one or more of the following advantages: suppress weeds thus reducing the use of herbicides; improves plant growth and increase the crop yield; increases beneficial microorganisms activity; protect the soil surface, improves soil structure, soil nutrients and maintains moisture in the soil. Use of soil cover (mulches sheet) has a major role in the conservation of soil moisture and can control weeds up to a positive level without use of herbicides. Therefore, , mulch does not only suppress weeds, but also maintains soil moisture at higher levels compared to unmulched soil and increasing productivity of crops(Edwards *et al*., 2000; Mahajan *et al*., 2009 and Jordán *et al*., 2011). Mulching film used as an integrated weed management in an agro-ecosystem which may selectively give weed control through their physical presence on the soil surface and prevents nutrient loss, particularly nitrogen loss as volatilization and more availability of nitrogen increases vegetative growth (Iqbal *et al*., 2014) enhancement of soil temperatures (Wang *et al*., 2015) and changes in soil nutrient availability (Wang *et al*., 2016).

Among all enzymes in the soil environment, dehydrogenases are one of the most important oxidoreductase enzymes. Dehydrogenase is an enzyme that occurs in all viable microbial cells (Watts *et al*., 2010 and Zhang *et al*., 2010). Dehydrogenase activity is one of the most adequate, important and one of the most sensitive bio-indicators used to indicate overall soil microbial activity (Salazar *et al*., 2011), and its relation to the soil nutrition and fertility (Wolinska and Stepniewska, 2012), because they occur intracellular in all living microbial cells and tightly linked with microbial oxido-reduction processes (Yuan and Yue, 2012). However, Islam and Borthakur (2016) screened the influence of growth stages of rice at 30, 60, 90, 120 and 150 days after rice seedlings transplanted on soil microbial biomass carbon and enzyme activities (amylase, dehydrogenase, alkaline and acid phosphatase) in a sub-tropical rice at two soil depth (0-10 and 10-20 cm). Results shows that, contents of soil organic carbon, and total nitrogen, microbial biomass carbon were highly influenced by the flowering stage 90 days after rice seedlings transplanted of the rice crop, at both 0-10 cm and 10-20 cm soil depths, but decline gradually when the crop reaches maturity 120 days after rice seedlings transplanted and late maturity stages 150 days after rice seedlings transplanted. The soil organic carbon and total nitrogen were positively correlated with microbial biomass carbon. Both dehydrogenase and phosphatase showed significant correlation with microbial biomass carbon.

Using paper mulches lower soil temperature as compared to black plastic or bare soil. Nevertheless, paper mulch tended to give more uniform temperature than the other mulch treatments. Also, the color of mulching paper has had an effect

* **Corresponding author.**
E-mail address: wfa_agr@yahoo.com
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on the soil temperature. Coated brown kraft paper has been observed to lighten in color over the growing period leading to reduced soil warming later in the season (Shogren and David, 2006). Under these ground cover conditions, evaporation can be effectively reduced compared with bare land conditions, so this system have a greater water use efficiency than "aerobic rice" (Qin *et al*., 2006b – Qin, 2006 a). This can reduce irrigation frequency and amount of water, and it has been widely applied throughout the world (Li *et al*., 2006). A recent studies of rice crop mulching cultivation has been developed in 1980s as one of water saving management practices for rice production, and introduced it as a new rice cultivation technique in many regions of China to use only 40% of the amount of water usually needed to grow rice in submerged conditions and the total planting area cultivated with this technique has reached 100,000 ha to control the growth of weeds (Li *et al*., 2007)., Both of a biodegradable mulch paper and brown kraft paper could keep the soil moister than commercial plastic mulch (Zhang *et al*., 2008). Moreover, mulching can conserve soil moisture and modify its physical environment (Chakraborty *et al*., 2008 and 2010). Therefore, the mulching cultivation system could be a promising technology to promote rice grain yield formation and water use efficiency (Gu *et al*., 2012). Mulch application was also helpful in reducing the number of non-productive tillers and sterile spikelets, and improving the productive tillers, kernel number and size, and kernel quality. Jabran *et al*. (2015) Moreover, using mulching of biodegradable film reduced the environmental pollution in ground cover rice production system by herbicides and improved yield productivity Zhang *et al*. (2017).

From the point of previous view, the main objective of this study is using the mulching rice cultivation technique with degradable materials (paper) as an environmentally friendly and safe method to suppress weeds in transplanting rice fields without using any contaminating herbicides. However, the specific objectives were to speed the growth of seedling, shorter heading period and increase rice yield and quality.

MATERIALS AND METHODS

Experimental Field

The experimental field was taken at the Research Farm of Rice Mechanization Center (RMC), Meet El-Dyeba, Kafr El-Sheikh during two summer seasons of 2018 and 2019. The soil of experimental field is clay, while the other mechanical and physical soil properties are presented in Table (1).

Table 1. The mechanical and physical soil properties of the experimental field.

Soil depth, cm	Particle size distribution			Soil texture	Field capacity, %	Bulk density, g/cm^3
	Sand, %	Silt, %	Clay, %			
0-15	10.42	31.25	58.33	Clay	44.80	1.10
15-30	13.00	32.00	55.00	Clay	41.45	1.22
30-45	12.00	29.00	59.00	Clay	39.00	1.28
45-60	12.00	28.00	60.00	Clay	37.40	1.31

Study treatments and experiment layout

In this experiment, three different colors (White, Gray and Brown) of mulching paper were used. Each color used with two different masses/m^2 (120 and 180 gr/m^2). Six study treatments were arranged from the available color and weights/m^2 of mulching paper compared with two uncovered control treatments as follows:

1: Covered plot with white paper, 120 gram/m^2; (W1).
2: Covered plot with white paper, 180 gram/m^2 ; (W2)
3: Covered plot with gray paper, 120 gram/m^2; (G1)
4: Covered plot with gray paper, 180 gram/m^2; (G2)
5: Covered plot with brawn paper, 120 gram/m^2; (B1)
6: Covered plot with brawn paper, 180 gram/m^2; (B2)
7: Uncovered plot with using herbicide; (H).
8: Uncovered plot without using any herbicide; (C).

The experimental field was fine prepared and divided into 8 plots at rectangular shape. Each plot has dimensions of 3600 × 1400 mm and 500 mm border width between plots. All plots were irrigated and puddled, then covered with mulching paper. The mulching paper treatments used in this experiment was cut with same dimensions of experimental plots and perforated with holes (125mm diameter) at spacing of 200×200 mm. The rice seedlings of Giza 178 variety used in this experiment were pre-cultivated in parachute seedling trays. The hills of seedling (5 - 7 seedling/hill) 150 mm heights and 25 days age were transplanted in all holes of mulching paper for all treatments under study. However, the two uncovered control treatments were transplanted with same seedlings at same spacing directly on the soil. The study treatments were randomly distribution for all experiment plots and arranged in complete random plot design with three replicates as shown in Fig. (1).

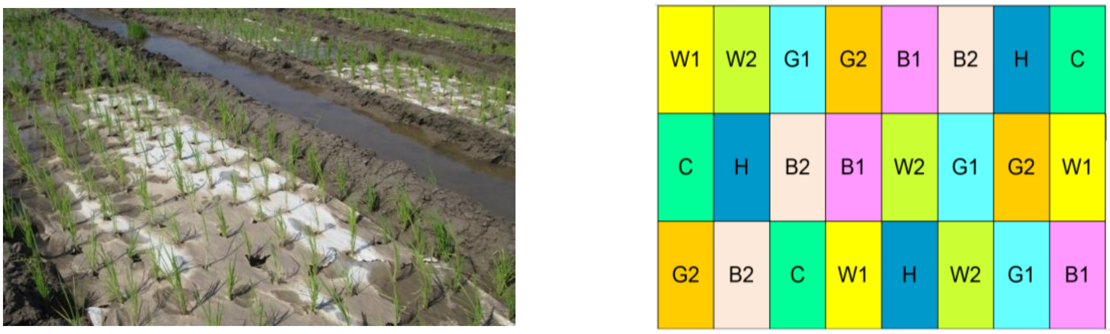

Fig. 1. Experimental field photo and layout design

Experimental Measurements

During the rice crop growth and at the harvest time of this experiment some measurements such as weed control efficiency, useful life period of mulch paper, soil microbial biomass; dehydrogenase enzyme activity; soil available nutrients (N, P and K); rice crop yield, its components, crop index and rice grain quality. These experimental measurements were taken at four different times of rice growing stages as the follow, 1st measuring time before rice seedling transplanting immediately (0 days) ; 2nd measuring time (45 days after transplanting); 3rd measuring time (90 days after transplanting); and 4th measuring time (135 days after transplanting). The rice growing period was divided into three stages. 1st stage starting from transplanting date up to 45 days of transplanting, 2nd stage starting from 45 day up to 90 days after transplanting and 3rd stage starting from 90 days up to 135 days.

1- Weed control efficiency %

The data on weed infestation and weed density were collected from each plot at 0, 45, 90 and 135 day after transplanting (DAT). A square frame of 0.25 m^2 was placed randomly at three different spots in the middle of each plot. To record weed dry mass, weeds were cut at ground level, washed with water, the fresh weeds were subjected to the oven temperature at 105°C within 5 minutes to kill the weeds. They were subsequently dried at 70°C for 72 h and then weighed. Weed control efficiency was computed using the following formula according to Singh and Kumar (1969):

$$\textbf{Weed control efficiency},\% = \frac{\textbf{Weed population in control plots} - \textbf{Weed population in treated plots}}{\textbf{Weed population in control plots}} \times 100$$

2- Useful life of mulching paper

The useful life of mulching paper is defined as paper validity period for using it to suppress the growth of rice weeds at 75% paper decomposition degree. Therefore, the seasonal changes starting date of decomposition degree for all mulching paper treatments under study were observed and recorded during rice crop growing stages until decomposition degree of 95% of mulching paper.

3- Soil microbial and related nutrients activities

In this study the activity of Dehydrogenase enzyme was taken as an indicator of overall soil microbial activity. Also, the activity of soil microbial biomass, soil organic matter and available soil nutrients such as N (Nitrogen), P (Phosphorous) and K (Potassium) were measured and determined at four decided measuring times during growing stages of rice crop. The soil samples were randomly collected from each experimental plot to at 0–10 cm depth with three replicates at decided different growth stages rice crop. The soil samples were air dried for 48 hour, sieved to <45 mm and sent to microbiology laboratory of Soil Science and Water Research Institute, Agric. Research Center, Sakha, Kafr El-Sheikh for measuring soil microbial activity and soil available nutrients according to their analyzing protocol

4- Crop yield, its components and crop index

An area of 1 m^2 including the crop sampling zone was harvested for measurements of grain and straw yields. Also, yield component such as number of panicle/m^2, straw and grain mass gram/m^2, panicle length cm, plant length cm, number of grain/panicle and weight of 1000 grain (gr) were measured and calculated for each treatment at harvesting time for rice variety of Giza 178 under study. The total obtained grain yield and its components for each treatment under study was determined and calculated by ton/Fed.. Also, harvest index (HI) for each treatment under study was determined and calculated according to the following equation as an indicator for productive efficiency and it is could be defined as the ratio between the total weight of harvested grains and the total weight of biomass yield.

$$\textbf{Harvest index}\ \frac{\textbf{Total mass of harvested grains}}{\textbf{Total mass of biomass yield (Grains + Straw)}}$$

5- Rice grain quality

Rice grain hardness, kg/cm^2; milling recovery, %; broken rice grain, % and degree of rice milling, % were estimated as an indicators of rice grain quality., Five samples of rice grains were taken randomly from each treatment under study after rice harvesting time to determine grain quality measurements. Hardness of rice grains was tested by using the hardness device, Model (#174886 Kiya Seisakusho LTD). The milling percentage of rough rice was evaluated in terms of total milling yield and percentage of broken rice. For each treatment 125gm of rough rice sample was husked using Satake rubber roll husker, Model (ST-50) and polished using Satake rice polisher, model (SKD-DBKK). A laboratory grader, Model (TRG-05A) was used for separating head rice from the broken rice. Total milled rice recovery and broken rice percentage were measured using the following equations:

$$\textit{Milling Recovery},\% = \frac{\textbf{Mass of Milled Rice}}{\textbf{mass of rough rice sample}}$$

$$\textit{Broken Rice},\% = \frac{\textbf{Mass of Broken Rice}}{\textbf{Mass of Rough Rice sample}}$$

However, the brown rice in the milling rice grain samples was manually selected and weighted to calculate the rice milling degree, % using the following equation:

$$\textit{Rice milling dgree},\% = \frac{\textbf{Mass of brown rice grains} - \textbf{Weight of milled rice grains}}{\textbf{Mass of brown rice grains}} \times 100$$

RESULTS AND DISCUSSION

1- Weed control efficiency

The results of the effect of rice mulching treatments on weed growth compared with control treatment during growing stages of rice crop as shown in Fig. (2), revealed that weed density was significantly reduced by high percentages for mulching paper plots compared with control plot and the use of rice mulch was found to be effective in weed suppression under this study due to the lowest weed density, weed dry weight, and highest weed control efficiency.

Also, it could be indicated that using any given color of 180 g/m^2 mulching paper give the highest value of weeding efficiency, (100%) compared with (95-97%) for 120 g/m^2 mulching paper with any given color and compared with (76%) as an average for herbicide treatment. This cleared that the weed control results mentioned that the growing weeds appeared only in the mulching paper of 120 g/m^2 treatments after paper decomposition by about 75% between the 2nd and 3rd rice growing stages (60 day after rice seedlings transplanting).

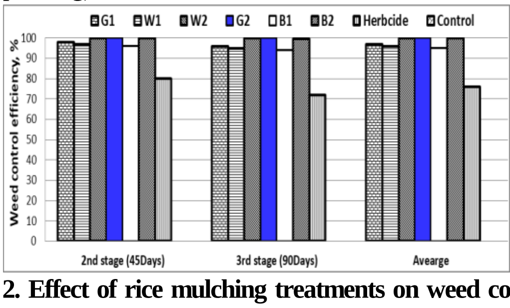

Fig. 2. Effect of rice mulching treatments on weed control efficiency during growing stages of rice crop.

2- Useful life of mulching paper

The useful life of mulching paper is defined as paper validity period for using it to suppress the growth of rice weeds at 75% paper decomposition degree. Therefore, the seasonal changes starting date of decomposition degree for all mulching paper treatments under study were observed and recorded during rice crop growing stages until decomposition degree of 95% of mulching paper.

The recorded data of useful life for mulching paper (Fig. 3) was observed at 60 days after transplanting at 75% paper decomposition degree for all colors mulching paper treatments of 120 g/m^2 under study and achieved to more than

95% of paper decomposition degree at 90 days after transplanting. However, the useful life (at 75% paper decomposition degree) for 180 g/m^2 mulching paper with any color was observed at 75 day after transplanting and achieved to 95% of paper decomposition degree after 120 days from rice seedlings transplanting. In other words, it could be noted that using any given color of 180 g/m^2 mulching paper gave the highest data of useful life (90 days) than that obtained for 120 g/m^2 mulching paper (60 days) with any given color under study. In that time, the progress of density and height for rice crop plants will be satisfied to minimize the chances of weed emergence.

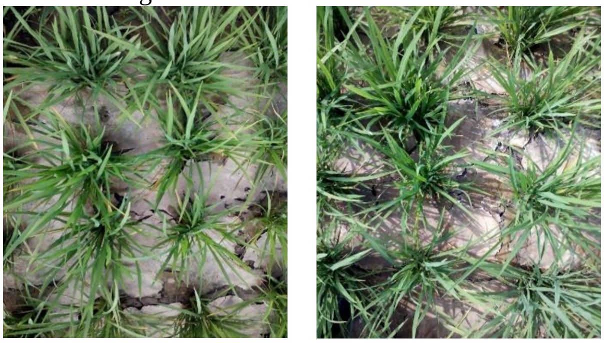

Fig. 3. The seasonal changes of mulching paper decomposition degree.

3- Soil microbial and related nutrients activities

In this investigation study, the soil dehydrogenase activity was used as a bio-indicator of metabolic state of soil microorganisms. In addition to total soil microbial mass, which is highly correlated with soil quality organisms that reflect the state of soil fertility and organic matters which are the preferred energy source for microorganisms, where the soil ecosystems with the high organic substances tend to have higher microbial biomass contents as well as its activates. The effect of mulching variables on the total microbial biomass and dehydrogenase activity at different four measuring times during rice crop growing season compared with herbicide and control treatments is shown in Fig.(4) from this results it could be indicated that, there a positive correlation between total soil microbial biomass or soil dehydrogenase activity and experimental treatments.

Generally values of the total microbial and dehydrogenase enzyme activity were found to be increased from 1st measuring time (at rice seedlings transplanting time) to 2nd measuring time (45 days after rice transplanting) and also, to 3rd measuring time (90 days after rice transplanting) However, the values were decreased from 3rd measuring time to 4th measuring time (135 days after transplanting) after rice crop harvesting. Also, from the obtained results in Fig. (4) it could be showed that the mulching treatment of (G1) gave the highest values of total soil microbial biomass at 2nd, 3rd and 4th measuring time of 120, 210 and 180 mg/kg respectively. While the mulching treatment of (C) gave the lowest values of total soil microbial biomass 86.0, 165.0 and 89.0 mg/kg at 2nd, 3rd, and 4th measuring times respectively.

Also, from the obtained results in Fig.(4) it could be showed that the mulching treatment of (G1) gave the highest values of dehydrogenase enzyme activity at 2nd , 3rd and 4th measuring time of 53.31, 71,08 and 57.54 mgg^{-1}dry soil/96h respectively. While the mulching treatment of (C) gave the lowest values of dehydrogenase enzyme activity 31.26, 41.68 and 36.84 mgg^{-1}dry soil/96h at 2nd, 3rd and 4th measuring times respectively.

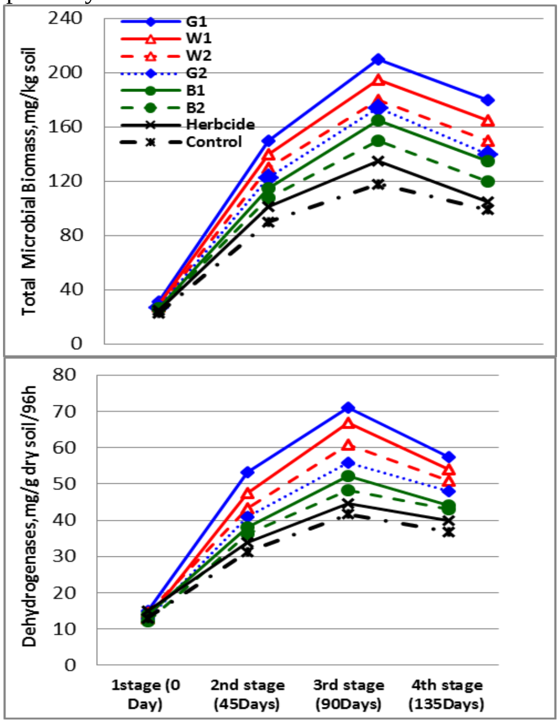

Fig. 4. Effect of mulching and control treatments on the total soil microbial biomass and dehydrogenase activities at different rice growing stages.

In the other words, the records of total soil microbial biomass or dehydrogenase enzyme activity values of (G1); (W1); (W2); (G2); (B1); (B2); (H) and (C) at any given measuring time of rice crop growing. Regarding to the effect of measuring time for each growing period it could be said that the highest values of total soil microbial biomass or dehydrogenase enzyme activity were obtained at stage of 3rd measuring time of growing season. However, at the last growing stage the values of total microbial biomass and dehydrogenase enzyme activity were decreased for all study treatments, but the values still remain higher than obtained at 3nd stage of measuring time of this growing stage for all given study treatments. This result may be due to high consumption of rice crop plots during flowering and ripping periods at the last measuring time, in addition to the decreased in soil moisture content after stop irrigation, consequently decreased the microorganisms activity

The highest value of organic matter were obtained at first stage of rice growing crop (1st measuring time), then decreased from stage to stage until to reach to the lowest values at last growing stage of rice crop(4th measuring time). This trend may be due to increase the soil microorganisms' activity from growing stage to other which the consumption of organic matter b these microorganisms. Regarding to the effect of using different mulching treatments it could be said that the mulching treatment of plots covered with gray paper (120 g/m^2) gave the lowest values 3.130, 1.890 and 0.978% at 2nd, 3rd and 4th measuring time respectively compared with the other mulching treatments and control treatment. However, the control treatment gave the highest values of organic matter 4.170, 2.970 and 1.685 at 2nd, 3rd and 4th measuring time, respectively as shown in Fig. (5).

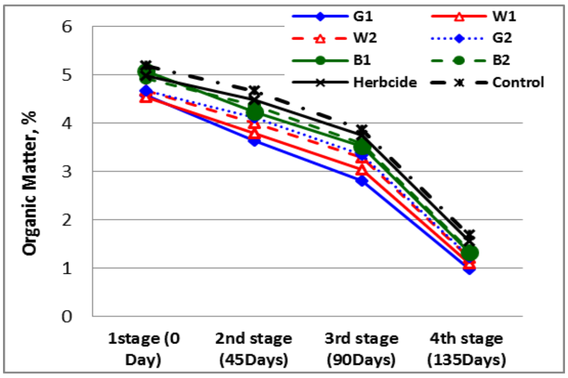

Fig. 5. Effect of mulching and control treatments on the soil organic matter at different rice growing stages.

The obtained data in Fig. (6) indicated that the total amounts of nitrogen (N); potassium (K) and phosphorus (P) were tankan the same trend of total of the total soil microbial biomass and dehydrogenase enzyme activity under the different growing rice crop stages (measuring times) for all given study treatments. It was increased from 1st stage to 2nd stage and from 2nd stage to 3rd stage, then decreased from 3rd stage to 4th stage again for any given study parameters.

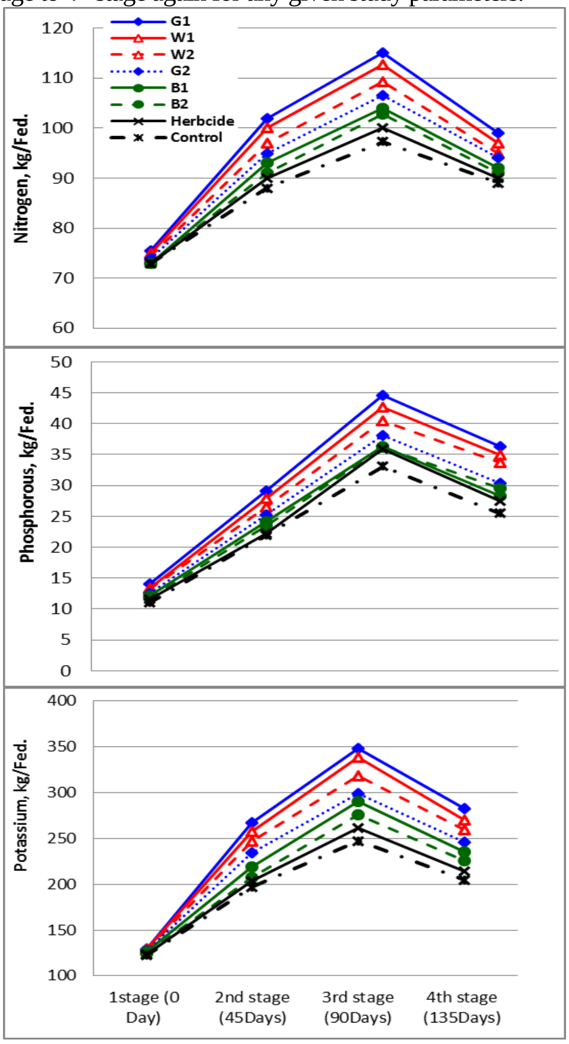

Fig. 6. Effect of mulching and control treatments on total soil nutrients of N, P and K at different rice growing stages.

The obtained values of the amounts of of N or P and K under the study mulching and control treatments were found in the following of (G1); (W1); (W2); (G2); (B1 (B2); (H) and (C) at any given measuring time of rice crop growing stage. compatible with the results of total soil microbial biomass and dehydrogenase enzyme activity due the positive correlation between them, which cleared that the soil nutrients increased by increasing the soil microorganisms activity.

4- Rice yield and its components.

Effect of mulching and control treatments on the rice crop yield and its components of No. plants/m^2 Spike length, No. panicles/spike, weight of 1000 grain, grain yield, straw yield, and harvest index are summarized in table (2). The obtained results in this table cleared that the mulching treatment of (G1) produced the highest value of grain and straw yield 5.265 and 6.696 ton/fed respectively. However, the lowest value of grain and straw yield were obtained from (C). Also the values of yield components taken the same trend of both treatments (G1) and (C). The treatments of uncovered plot with using herbicide give the higher values of grain yield and its components than obtained from control treatment of uncovered plot without using any herbicide but these values still lower than that obtained from any given mulching treatment under study.

The mulching treatment of (G1) gave an increment percentages in rice grain and straw yield by about 29.07 and 34.42 %, respectively compared with herbicide treatment (H) and by about 62.70 and 41.83%, respectively, compared with control treatment (C).

Table 2. Effect of mulching and control treatments on rice yield and its components and harvest index

Treatments	No. spike s/m^2	Spike length, cm	1000 grain weight, g	Grain yield t/fed.	Straw yield t/fed	Harvest index
G1	453.333	23.293	24.883	5.265	6.696	47.706
W1	417.000	23.073	24.533	5.099	5.5.89	47.034
W2	413.333	22.367	23.967	4.905	5.524	46.849
G2	411.667	22.320	23.567	4.697	5.502	45.858
B1	398.000	21.913	23.433	4.583	5.350	45.446
B2	390.000	21.767	23.250	4.532	5.328	45.025
Herbicide (H)	380.333	21.760	22.150	4.080	4.981	44.022
Control(C)	370.333	20.947	21.367	3.236	4.721	40.671

Also, it could be mentioned that, the paper gray color of the mulching paper gave the best results of rice grain and straw and its components compared with the other colors of white or brown. However, the mulching paper density of 120 g/m^2 gave the best results of rice grain, straw and its components compared with the other density of 180 g/m^2. These results may be due to increasing the soil microorganism activity and its nutrients and saving soil moisture content under paper amounts for gray color 120 g/m^2 white or brown paper. While the paper density in comparison with white or brown paper and 180 g/m^2 paper density.

5- Rice grain quality

Effect of mulching and control Treatments on rice grain quality (Milling recovery (%), Head yield(%), Broken grain(%), Milling degree(%) and Hardness, kg/cm^2 are listed in table (3). The obtained result indicated that the applying mulching treatments on rice cultivation increased Milling recovery (%), Head yield (%) Milling degree (%) and Hardness, kg/cm^2 and decreased Broken Grains (%). Compared with herbicide and control treatments.

The mulching treatment of covered plot with gray paper (G1), 120 g/cm^2 gave the best results of grain quality (highest value of milling recovery, Head yield, Milling degree and Hardness in addition the lowest values of broken grains). However, the (H) and (C) treatments gave the lowest values of grain quality but the values of grain quality of herbicide treatment still higher than that obtained from control treatment. Regarding to the other mulching treatments, it could be cleared that the mulching treatment of covered plot with white paper 120 g/m^2 gave the 2nd order of the best results of grain quality, followed with, covered plot with white paper, 180 g/m^2 (W2) then covered plot with gray paper 180 g/m^2 (G2), then covered plot with brown paper 120 g/m^2 (B1) and covered plot with brown paper 180 g/m^2 (B2). These results may be due the best condition of rice crop growing stages under applying different mulching treatments.

Table 3. Effect of mulching and control treatments on rice grain quality.

Treatments	Milling recovery, %	Head yield, %	Broken Grains, %	Milling Degree, %	Hardness, kg/ cm^2
G1	78.14	71.31	6.832	18.64	4.96
W1	78.10	70.47	7.621	17.70	4.59
W2	78.07	69.82	8.245	17.13	4.47
G2	77.99	69.43	8.560	16.96	4.46
B1	77.92	68.59	9.325	16.94	4.26
B2	77.79	68.21	9.587	16.53	4.20
Herbicide (H)	77.57	64.85	12.723	15.33	4.07
Control (C)	77.52	63.43	14.088	14.90	3.84

CONCLUSION

The obtained results of this experiment concluded that: Using any given color of mulching paper of 180 g/m^2 give the highest value of weeding efficiency,(100%) compared with 95 - 97% mulching paper (any given color) of 120 g/m^2 and 76% as an average for herbicide treatment. Therefore, the use of rice mulch was found to be effective in weed suppression. Using any given color of 180 g/m^2 mulching paper gave the highest data of useful life (90 days) than that obtained for 120 g/m^2 mulching paper (60 days) with any given color under study.The mulching treatment of covered plot with gray paper 120 g/m^2 gave the highest values of dehydrogenase enzyme activity at 2nd, 3rd and 4th measuring time of 53.31, 71.08 and 57.54 mgg^{-1}dry soil/96h respectively. The total amounts of nitrogen (N); potassium (K) and phosphorus (P) were increased from 1st stage to 2nd stage and from 2nd stage to 3rd stage, and then decreased from 3rd stage to 4th stage again for any given study parameters. The mulching treatment of covered plot with paper gray color, 120 g/m^2 produced the highest value of grain and straw yield of 5.265 and 6.696 ton/fed., respectively and gave the best results of grain quality.

Recommendation

The authors recommended to apply biodegradable mulching material (paper) for rice cultivation under Egyptian conditions as an environment friendly technique to suppress rice weed growth, improve the existing water saving due to less transpiration by the weeds, recycled nutrients to feed crop plants due to high soil microbial biomass content and dehydrogenase activity. Furthermore, saving labors to gather waste plastic film which is burned after collection and buried in soil causing soil pollution compared with mulching paper which is completely decomposed during growing crop season and save the agricultural environment from using herbicides. In addition to use the obtained results of this study as base data for developing rice transplanter to perform mulching laying and transplanting simultaneously in future study.

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مقاومة حشائش الأرز المشول باستخدام تقنية التغطية بالورق

وائل فتحى على المتولى ، محمود السيد العراقى ، محيى الدين العيسيلى و إسماعيل فؤاد سيد أحمد
معهد بحوث الهندسة الزراعية ، مركز البحوث الزراعية ، ص ب 256، الجيزة ، جمهورية مصر العربية

أجريت هذه الدراسة بهدف استخدام تقنية تغطية سطح تربة الارض المنزرعة أرز بطريقة الشتل بمواد قابلة للتحلل (الورق) لقمع ومقاومة نمو حشائش في حقول الأرز دون استخدام أي من مبيدات الحشائش الملوثة للبيئة كطريقة صديقة للبيئة وآمنة. لذا تم استخدام ثلاثة ألوان مختلفة من ورق التغطية (أبيض ، رمادي ، بني) ، و كل لون تم استخدامه بكثافة وزنية لوحدة المساحة من الورق (120 و 180 جرام/ م^2) لتغطية القطع التجريبية تحت الدراسة ، مقارنة بقطعة تجربية غير مغطاة بالورق واستخدم فيها مبيدات الحشائش وقطعة تجريبية أخرى غير مغطاة بالورق ايضا ولم تستخدم فيها اى من مبيدات الحشائش. ولتحقيق الهدف من هذه التجربة تم تحديد قياسات كفاءة مقاومة نمو الحشائش؛ العمر الفعال لورق التغطية؛ النشاط الحيوى للكائنات الحية بالتربة وتأثيرها على انزيم الدهيدروجينيز وكذلك العناصر الغذائية المرتبطة بتلك النشاط الحيوى؛ إنتاجية محصول الارز ومكوناتها ومؤشر الحصاد لها ؛ وأيضا جودة حبوب الأرز أثناء موسمى زراعة الأرز 2018 و 2019. وقد أظهرت النتائج المتحصل عليها ما يلي: * أدى استخدام أي لون من معاملات ورق التغطية 180 جرام/ م^2 للحصول على أعلى قيمة لكفاءة مقاومة الحشائش (بنسبة 100%) مقارنة بمعاملات ورق التغطية 120 جرام/ م^2 من أي لون معين (بنسبة 95-97%) بينما كانت (بنسبة 76%) لمعاملة القطعة التجريبية الغير مغطاة بالورق ومستخدمة لمبيدات الحشائش مما اثبت ان تقنية التغطية هذه كانت فعالة في القضاء على الحشائش. * أظهرت جميع معاملات ورق التغطية 120 جرام/ م^2 بألوانها تحت الدراسة تحلل الورق بها بنسبة 75% بعد 60 يومًا بعد الشتل ثم تم تحلل أكثر من 95٪ من الورق بعد 90 يومًا من الشتل. بينما تحلل ورق جميع معاملات التغطية لـ 180 جرام/ م^2 بأي لون تحت الدراسة بنسبة 75% بعد 75 يومًا بعد الشتل ثم تم تحلل أكثر من 95٪ من الورق بعد 120 يومًا من شتل شتلات الأرز. * أعطت معاملة القطعة التجريبية المغطاة بورق رمادي اللون 120 جرام/ م^2 أعلى قيم للنشاط الحيوى للكائنات الحية بالتربة متمثلة فى قيم إنزيم الدهيدروجينيز في زمن القياس الثاني والثالث والرابع من 53.31 و 71.08 و 57.54 ملجم / 1 جم تربة جافة / 96 ساعة على التوالي. * ارتفع محتوى التربة من النيتروجين (N) و البوتاسيوم (K) والفوسفور (P) من مرحلة النمو الأولى إلى المرحلة الثانية ومن المرحلة الثانية إلى المرحلة الثالثة ، ثم أخذ الانخفاض من المرحلة الثالثة إلى المرحلة الرابعة مرة أخرى لأي من معاملات التجربة تحت الدراسة. * أعطت معاملة القطعة التجريبية المغطاة بورق رمادي اللون 120 جرام/ م^2 أعلى قيمة لمحصول الحبوب والقش والتى بلغت 5.265 و 6.696 طن / فدان على التوالي. كما أعطت أيضا أفضل النتائج من حيث جودة الحبوب .