ISSN: 03875547
Volume 44, Issue 06, December, 2021

The Use of Cow Dung- Polyurethane Mattresses as an Agricultural Soil

Amjed T. Battor[1*], Mohammed. A. Jaber[2], Chasib K. Bakakh[3], Duniah. M. Naji[1]

University of Basrah, College of Education/Qurna, Department of Chemistry, Iraq[1]
University of Basrah, Polymer Research Center, Department of Material Science, Iraq[2]
Iraq Driling company, Basrah, Iraq[3]

Corresponding author: 1*

Keywords:
cow dung, old mattress, foam, north of Basarh, Iraqi wheat, soil.

ABSTRACT

This study examined polyurethane foam as waste through the use of old foam mattresses made of polyurethane foam that is thrown out in large quantities and areas in landfills. It is widely known that polyurethane foam waste decomposes over time and that its collection pollutes the environment. Old modified foam mattresses are used in place of agricultural soil. This foamy soil was made by dipping pieces of foamy mattress in dissolved cow dung for ten days, and then testing it with three types of plants (Lepidium sativum), (Portulaca oleracea), and wheat. In the first instance, the germination time of (Lepidium sativum) and (Portulaca oleracea) reached 18 hours instead of two or three days. Rather than ten to twelve days, wheat was harvested within five to six days. Many measurements have been taken, including the ratio of growth, the speed of germination, the height of the stem, the size of the leaves, and others. The result obtained was compared with the reference plant grown on adjacent land for comparison purposes in terms of growth under similar conditions and weather factors.

1. INTRODUCTION

The need to develop a new agricultural methods and techniques to increase crop production is still progressing in trust and wide steps [1- 3], as some crops require specific circumstances to grow. There are a few strategies that have made a difference in modern agriculture around the world. In sandy soils, a polymer is one most recent solutions for irrigation [4- 5]. It is extremely absorbent to water, with a retention capacity of more than 300 times its volume. As a consequence, it is regarded as a good soil conditioner and a good alternative to compost, with benefits such as reducing irrigation water use and using wastewater as a fertilizer [9], [10]. Water and nutrients are better absorbed by plants, resulting in cost savings. Irrigation energy, destruction of equipment, and the development of bananas using less water [10], [11]. A superabsorbent polymer is used in agriculture and horticulture because it is used to save large amounts of water quickly, and because it has a specific application in fertilizers, the polymer can improve nutrient retention capacity [12- 14]. In addition to reducing irrigation and watering rates, a hydrogel can improve soil aeration, minimize erosion, and prevent runoff leaks because the release of these nutrients is regulated. As a result, agricultural production costs are reduced [14- 16].

Polyurethane foam insulation has been used in agriculture since the 1990s. Due to its tightness and durability, this material is ideal for the spray insulation of farm and industrial buildings. It adheres firmly to the ground. It is also resistant to mold and fungi formation, and their harmful effects, making it particularly useful in agriculture [17- 20]. Recent research suggests that creating polymer composite films of cow dung fibers and polymers such as polyvinyl alcohol (PVA) or poly (lactic acid) [21] could be a quality used for cow dung which is readily available all over the world [22].

In the present study, polyurethane mattress was used as agricultural soil, which was reinforced with cow dung where the study used three kinds of plants to see how this artificial soil affects plant growth and some other properties of these plants.

2. Experimental

The animal dung for this study was collected from a livestock farm in Al-Madina's wetlands near Basrah, Iraq. The animal dung was sieved multiple times with a tiny size sieve until it was reduced to small particles, after which it was collected and placed in a container (pail). After adding a little water and shaking thoroughly, it was left for three days. To maintain a well-consistent mixture, water was added every day to keep homogenization going. After ten days of mixing the manure with water, the old modified foam mattress bed (old modified foam mattress foam) placing in the plastic container, provided that it is completely covered with the water-dung mixture for ten days. Next, the old foam mattress was lifted off the ground by placing it on a piece of wood. After that, some grains of (Lepidium sativum) and (Portulaca oleracea) were scattered on top of this old modified foam mattress bed inlaid with animal dung pellets. The first day of November 2020 is the start of the agriculture season for both seeds.

After that, a research idea was developed using the same old mattress soil submerged in dung and mixed with wheat cultivation. In a test that involved planting 100 grains of wheat and monitoring germination, observations were made regarding the height, the growth of the leaves, chlorophyll content, stem width, and several other factors.

3. Results and Discussion

Both (Portulaca oleracea) and (Lepidium sativum) were planted in the modified soil as the first plants to test their suitability as alternative soil. The first noticeable result was that both types of used seeds germinated within 18 hours which is shorter than the three days for the usual germination time of both seeds. Also, the germ nation rate of both seeds is more than 95%. Second, the difference in results was due to the time of year when the plants were grown: (Lepidium sativum) for its designated winter period, and (Portulaca oleracea) for its designated summer period. Therefore, the yellow color of the plant (Portulaca oleracea) has begun to appear. The (Lepidium sativum) plant, on the other hand, displayed a dense and rapid growth rate, as well as a high green percentage, suggesting a high chlorophyll content.

It can be seen from the figure (1) that relocation of roots into artificial soil, which is rich in cow dung and saturated therein, enhanced the absorption of fertilizer by roots and therefore accelerated growth.

Figure (1) the growth of both (portulaca oleracea) and (Lepidium sativum)

All of these noticeable results were then followed by the more important and economically significant aspect of agriculture: wheat growing. Having this light artificial soil available for growing desert or marshy areas that cannot be farmed or are too salty for farming, and placing it on the surface, has already been discussed previously. The fields are then farmed.

On the surface of this artificial soil, wheat seeds were planted, and the number of seeds planted was counted to determine the percentage of germination, with a total of 100 seeds. Within five days, the germination phase starts to emerge. The other characteristics of this plant were evaluated in terms of growth, stem thickness, percentages of germination, leaves width, and chlorophyll percentage, which are vital properties that must be acquired and researched to evaluate the efficacy of this artificial soil in the process of wheat cultivation. Figures (2-5) illustrates the changes in the wheat plant as time passes. Figure (2) illustrates the distribution of the seeds, and figure (3) represents the first stages of the germination process. The amount of growth in the stem and leaves, as well as the height and lengthening of these stems, is illustrated in Figure (4). Figuring (5) shows the penetration of wheat roots to the modified soil where this penetration is much more important since the stability of plants in windy seasons is also beneficial [23].

Figure (2) the wheat seeds distribution on modified soil.

Figure (3) the First of the germination of wheat on modified soil.

Figure (4) the amount of growth in the stem and leaf, as well as the height and lengthening of these stems.

Figure (5) the roots of wheat penetrate the modified soil

The percentage of germination, or the percentage of seedling emergence, out of 100 seeds is equal to the number of gestures divided by the total number of seeds. Table (1) contains all the obtained results.

Table (1) The percentage of germination as a function of time in days

Time of Germination (day)	The Germination %
First day	**15**
Second day	**40**
Third day	**77**
Fourth day	**85**
Fifth fay	**90**
Sixth day	**95**

Ten plants were randomly selected for measurement of their height in cm. From the surface of the soil to the base of the spike, the plant's height was measured. Table (2) gives information regarding plant height variations.

Table (2 The height of the plant after a week of germination

Number of plants	Plant height (cm)	Time (week)
16	**3**	**First week**
35	**7**	
39	**9-8**	
40	**14-13**	**Second week**
35	**16**	
15	**19**	
37	**16**	**Third week**
40	**20-19**	
13	**25-22**	

The number of spike grains is another significant parameter. The spikes were overgrown following harvest, and the spike grain yield was measured. Plant height was measured from soil contact point to growing top in centimeters and the average taken.

Leaf area was determined by collecting three leaves from each of the selected plants and representing as much of the plant as possible for 48 hours, or until their dry weight was constant. The area of the leaf was then determined using the equation as in reference (23). The obtained results are included in table (3).

Table (3) displays the rate of plant height, wheat leaf area, spike length, and quantity of grains per spike for the measures given above.

The rate of plant's height	69.34 cm

Wheat leaf area	36.44 cm^2
Spike length	12.56 cm
quantity of grains per spike	59

In addition to giving plants their green color, chlorophyll aids in photosynthesis by converting solar energy into chemical energy. Chlorophyll absorbs energy and then converts water and carbon dioxide into oxygen and carbohydrates through photosynthesis. Solar energy is transformed into usable forms by plants and the animals that consume them, forming the basis of several food chains. The estimated result of total chlorophyll was 22.17. (mg per 100 gm. of fresh) [24]. The weight of one hundred grains of wheat taken from the spongy soil is one of the most significant measures. The obtained weight is heavier more of those obtained by others [25- 27]. Figure (6) depicts a collection of images of wheat before and after harvest.

An accurate balance was used to weigh 100 grains, and the weight obtained was 4.9 g, which is similar to the weight of heavy grain. The researchers discovered that the average hectoliter weight of wheat is 77 kg, with the lowest being 74 and the largest being 80, and the average grain weight being 40. Lightest and heaviest weigh 32 and 50 milligrams, respectively. It is because of the nature of the old modified foam mattress, which is composed of interwoven polymeric chains. The intertwining produces voids within the polymeric sponge, which helps to retain nutrients, fertilizer, and water within. This means that the process of liberating this water and these stored fertilizers is a sequential, gradual process that keeps the plant from drying out, and the organic fertilizer is distinguished by its high cationic exchange cap.

Figure (6) the wheat spike before and after harvest

4. References

[1] K A El-Kazzaz, Aa El-Kazzaz. Soilless Agriculture a New and Advanced Method for Agriculture Development: an Introduction. Agri Res & Tech: Open Access J 3(2): ARTOAJ.MS.ID.555610 (2017).

[2] Hamid R. Roosta, Simin Afsharipoor. Effects Of Different Cultivation Media On Vegetative Growth, Ecophysiological Traits And Nutrients Concentration In Strawberry Under Hydroponic And Aquaponic Cultivation Systems. Advances in Environmental Biology, 6(2): 543-555, 2012.

[3] Carlos Otávio Rodrigues dos Santos, Antônio Pereira Júnior. Analysis of the Productive Capacity of an Aquaponic System with Macrobrachium Amazonicum (Heller, 1862) and Lettuce Culture (Lactuta Sativa Var. Crispa). International Journal of Science and Research (IJSR) (2018): 7.583ز

[4] Sonam S. Kale, Kishor P. Panzade, Narendra R. Chavan. Modern Farming Methods: An Initiative towards Increasing the Food Productivity. Food and Scientific Reports, April 2020, Volume 1: Issue 4 ,Page 34.

[5] Chavan Narendra Rameshsing, Kale Sonam Sureshrao, Kadu Tanvi Pradiprao, Toshy Agrawal, SB Verulkar. Identification of QTLS for root and agronomic traits in rice under water stress condition conditions. Journal of Pharmacognosy and Phytochemistry 2019; 8(3): 4302-4308.

[6] David R. Mutekanga, John Tusiime. The Modern Methods of Farming Adopted by Small Scale Farmers and How They Have Impacted Indigenous Knowledge: The Case Of Kagadi District, Uganda. Researchjournali's Journal of Agriculture Vol. 6 | No. 4 April | 2019.

[7] L. O. Ekebafe1, D. E. Ogbeifun, F. E. Okieimen. Polymer Applications in Agriculture. Biokemistri Volume 23, No. 2 (2011).

[8] Lawrence O. Ekebafe, David E. Ogbeifun, Felix E. Okieimen, Effect of Reaction Conditions on the Grafting Indices of Hydrolyzed Starch Copolymers. Nigerian Journal of Polymer Science and Technology, 2016, Vol. 11, pp 75-84.

[9] Hazem S. Elshafie and Ippolito Camele, Applications of Absorbent Polymers for Sustainable Plant Protection and Crop Yield. Sustainability 2021, 13, 3253.

[10] Faisal I. Zeineldin, Yousef Al-Molhim. Polymer and deficit irrigation influence on water use efficiency and yield of muskmelon under surface and subsurface drip irrigation. Soil and Water Research, 16, 2021 (3): 191–203.

[11] LiangyuChang, LijuXu, YaohuLiu, DongQiu, Superabsorbent polymers used for agricultural water retention, Polymer Testing, Volume 94, February 2021, 107021.

[12] Sabyasachi Behera, Prakash A. Mahanwar. Superabsorbent polymers in agriculture and other applications: a review. Polymer-Plastics Technology and Materials Volume 59, 2020 - Issue 4,341-356.

[13] M. J. Zohuriaan-Mehr, H. Omidian • S. Doroudiani, K. Kabiri. Advances in non-hygienic applications of superabsorbent hydrogel materials. J Mater Sci (2010) 45:5711–5735.

[14] El-Refaie Kenawy a , Mohamed M. Azaam a, Esraa M. El-nshar a. Sodium alginate-g-poly(acrylic acid-co-2- hydroxyethyl methacrylate)/montmorillonite superabsorbent composite: Preparation, swelling investigation and its application as a slow-release fertilizer. Arabian Journal of Chemistry Volume 12, Issue 6, September 2019, Pages 847-856.

[15] Jian-feng Zhang, Ting-ning Zhao, Bao-ping Sun, Shuang-shuang Song, Hu-bo Guo, Hao-jie Shen & Yi Wu, Effects of biofertilizers and super absorbent polymers on plant growth and soil fertility in the arid mining area of Inner Mongolia, China. Journal of Mountain Science volume 15, pages1920–1935 (2018).

[16] Fidelia Nnadi, Chris Brave, Environmentally friendly superabsorbent polymers for water conservation in agricultural lands, Journal of Soil Science and Environmental Management Vol. 2(7), pp. 206-211, July 2011.

[17] Qingyue Wang, Nuerjiamali Tuohedi. Polyurethane Foams and Bio-Polyols from Liquefied Cotton Stalk Agricultural Waste. Sustainability 2020, 12, 4214.

[18] Sophie M. Guillame, Hamdy Khalil, Manjusri Misra. Green and sustainable polyurethanes for advanced applications. Applied Polymer. Volume134, Issue45, December 5, 2017.45646.

[19] Claudia V. Vargas-Gutiérrez, Hans Th. Castro-Salazar, Carlos A. Ríos-Reyes. Synthesis and Properties of Polyurethane Foams Obtained from Cassava Starch and Rice by-products. J. Mex. Chem. Soc. 2018, 62(3) pp. 1-8.

[20] Subhashini Gunashekar, Krishna M. Pillai, Benjamin C. Church & Nidal H. Abu-Zahra, Liquid flow in polyurethane foams for filtration applications: a study on their characterization and permeability estimation. J Porous Mater (2015) 22:749-759.

[21] Isaac Mwangi, Grace Kiriro, Sauda Swaleh, Ruth Wanjau, Paul Mbugua,· Jane Catherine Ngila, Remediation of degraded soils with hydrogels from domestic animal wastes, International Journal of Recycling of Organic Waste in Agriculture (2019) 8:159–170.

[22] Mostafa Yusefi, Mohammad Khalid, Faizah Md Yasin, Abdullah Luqman Chuah. Mohammad Reza Ketabchi, Rashmi W. Performance of Cow Dung Reinforced Biodegradable Poly (Lactic Acid) Biocomposites for Structural Applications. Journal of Environmental Polymer Degradation 26(2)2018 .474-486.

[23] Umut Hasan, Mamat Sawut, Shuisen Chen. Estimating the Leaf Area Index of Winter Wheat Based on Unmanned Aerial Vehicle RGB-Image Parameters. Sustainability 2019, 11, 6829.

[24] Danijela Pavlović, Bogdan Nikolić, Sanja Đurović1, Hadi Waisi, Ana Anđelković. Dragana Marisavljević. Chlorophyll as a measure of plant health: Agroecological aspects. Pestic. Phytomed. (Belgrade), 29(1), 2014, 21–34.

[25] Desimir Knežević, Adriana Radosavac, Milica Zelenika. Variability of grain weight per spike in wheat grown in different ecological conditions. Acta Agriculturae Serbica, Vol. XX, 39 (2015);85-951.

[26] Danijela Kondić, Desimir Knežević, Aleksandar Paunović. Grain Weight Of Genotypes Of Triticale (X Triticosecale Wittmack) In Agroecological Conditions Of Banja Luka. GENETIKA, Vol. 44, No.2, 419-428, 2012.

[27] XiaoshuangLi, NiSong1, XiaojunShen, JingshengSun, HongkaiDang. Influence of irrigation mode on winter wheat production and moisture changes of wheat fields under extreme rainfall patterns. E3S Web of Conferences 144, 01005 (2020) WREM 2019.