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PROXIMATE COMPOSITION AND MINERAL CONTENT OF MAIZE GRAINS INFLUENCED BY MULCHING

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ABSTRACT

Chemical analysis of maize grains practiced with mulches materials were carried out in the Department of Agricultural Chemistry, University of Agriculture Peshawar, Pakistan during 2012. Maize variety "Azam" was grown at New Developmental Farm, University of Agriculture, Peshawar under different mulching materials viz. farmyard manure, chicken manure, black polyethylene plastic, white polyethylene plastic, *Eucalyptus* (chopped leaves) along with a hand weeding and a weedy check fro comparison. Grain samples collected from different mulching treatments were tested for moisture, crude fat, fiber and protein in the laboratory. The proximate composition results showed higher moisture (11%), crude fat (4.50%), crude fiber (2.81%) and crude protein (12.90%) contents in grains samples where farmyard manure was used as mulch followed by the black polythene plastic and the hand weeding. The lowest moisture, crude fat, crude fiber and crude protein (7.00, 2.87, 1.02 and 10.01%, respectively) were recorded for grain obtained from the weedy check. It was evident from the results that mulching did have some effects on nutritional composition of the maize grains. Thus, the nutritional composition quality of maize grains could be improved by applying farmyard manure as mulching material and for a good weed control.

Key words: maize, mulch, moisture, starch, fiber, protein content.

INTRODUCTION

Maize (*Zea mays* L.) belongs to Poaceae and is the third most important cereal crop in Pakistan after wheat and rice (PARC, 2013). Maize is used as a basic food ingredient, either in its original or modified form. Maize grains are a rich source of starch (72%), ash (17%), protein (10.4%), fiber (2.5%), oil (4.8%), vitamins and minerals (Farhad *et al*., 2009). The oil and protein contents are of

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commercial value and are used in food products manufacturing (Paliwal, 2000; Hobbs, 2003).

Mulch is a material that covers the soil surface to protect and to improve the covered area. It is of two types (organic mulch and inorganic mulch). Organic mulch includes leaves, barks, woodchips, grass clipping etc. while inorganic mulch includes polyethylene sheaths, pebbles, gravels etc. Mulching is a new and effective non-chemical weed control method (Kluepfel, 2013; Subhan *et al*., 2013). Organic mulches can lower the soil temperature, increase soil moisture, decrease weed density and encourage the overall crop yield (Sinkeviciene *et al*., 2009). It benefits the crop by increasing the crop growth and grain quality (Khaliq *et al*., 2004; Khurshid *et al*., 2006). It is useful to cover the soil surface with different materials to obtain high biological activity, retain soil moisture contents and achieve a good weed control (Sturny, 1998). Mulching is thought to have a significant effect upon the uptake of NPK by the crop plants (Sharma, 1994). Plastic mulch can be useful for soil moisture conservation, weed control (Awodoyin *et al*., 2007) and can increase the yield by up to 28% (Mahajan *et al*., 2007).

Keeping in view the impact of different mulching materials on proximate compositions of maize grains, a research study was undertaken with the objective to analyze the proximate composition of maize crop grains that was treated with different mulching materials.

MATERIALS AND METHODS

The present research work was performed at Department of Agricultural Chemistry, University of Agriculture, Peshawar. Maize variety "Azam" was collected from New Developmental Farm, University of Agriculture, Peshawar; where it was grown under different mulching materials (farmyard manure, chicken manure, black plastic, white plastic, and chopped leaves of *Eucalyptus*), along with a hand weeding. A weedy check was maintained for comparison. A dose of N and P fertilizers was applied at the rate of 150 and 90 kg ha^{-1}, respectively. Full dose of P and half of N was applied at the time of the crop emergence while the remaining half N was applied when the crop plants achieved knee height. All other agronomic practices were performed uniformly for all the treatments throughout the study. The collected maize seeds samples were analyzed for their proximate composition i.e. crude fiber, crude fat, crude protein and moisture, using the standard methods of AOAC (2000).

The grain moisture was determined by drying them in oven at 105^{o}C for 4 hours. Moisture content of each sample was calculated by the following formula:

Moisture (%) = (W1-W2/Wt of samples) x100

W1 is the weight of Petri dish + sample before drying and W2 is the weight of Petri dish + sample after drying.

Crude fat was determined by ether extract method using Soxhtec apparatus. Percent of fat in the sample was calculated as under:

Crude fat (%) = (Weight of the beaker + Ether extract) – (Weight of the beaker)/Weight of sample x 100

The percent crude fiber was calculated by the following formula:

Crude fiber (%) = (Weight loss on ignition)/Weight of sample x100

Protein contents were determined by Kjeldhal method of Bremner and Mulvaney (1982). Percent crude protein was calculated using the following formula:

Crude Protein (%) = %N x 6.25 (*factor for cereals)

%N = (S-B) x N x 0.014 x D x 100/Weight of sample x V

S is sample titration reading, D is dilution of sample after digestion, V is volume taken for titration, N is normality of HCl, B is blank titration reading and 0.014 is m. equivalent weight of N.

RESULTS AND DISCUSSION

Moisture (%)

The data regarding moisture content of maize grains treated with different mulching materials is presented in Table-1. The highest moisture content (11%) was recorded in grains obtained from farmyard manure mulch treatment followed by black plastic (10%). The lowest moisture content (7%) was recorded for the weedy check treatment. The results showed that different mulching materials increased moisture content of maize grain as compared to the weedy check. The literature showed that if the moisture is less than the desired range, the grain might be vulnerable to different diseases (Fry, 1982). The possible reason for high moisture content in grains obtained from farmyard manure mulch treatment might be less evaporation of soil moisture (Rafiq *et al*., 2010) and good weed controlled due to farmyard manure mulch. Thus, maximum moisture was utilized by the plant to increase grain moisture content and hence the yield (Khurshid *et al*., 2006; Ullah et al., 2010; Vita *et al*., 2007).

Crude Fat (%)

It was observed from the data in Table 1 that maize grains from farmyard manure and black plastic mulch plots have crude fat of 4.50 and 4.19%, respectively. Crude fat is one of the most important components of maize grains; improvement in fat content is useful for good human health. Hand weeding also showed promising results however, cost on hand weeding and plastic mulch is high and may not be desirable to be practiced by the maize growers and farmyard manure may be a desirable mulching practice for enhancing crude fat level of grains. Earlier studies (e.g. Bressani *et al*., 1990; Farhad *et*

al., 2009) have also reported mulching to be useful for the enhancement of maize grains quality.

Crude Fiber (%)

The data in Table-1 revealed crude fiber contents in grain treated with different mulching practices. Among the treatments higher crude fiber (2.81%) was noticed in grains treated with white farmyard manure whereas, lower fiber content (1.02%) was recorded in weedy check. Present results were in close proximity with those of Anakalo *et al*. (2009) and Golob & Plestenjak, 1999 they presented same results for crude fiber in manures. The use of mulch can improve fiber content of maize grains that is beneficial for health (Brunilda, 2010).

Crude Protein (%)

The data in Table-1 indicated that different mulches improved the protein content of maize grain as compared to weedy check. The proximate composition of maize grains treated with farmyard manure showed maximum crude protein content of 12.90% while minimum protein content 10.01% was observed for the weedy check. According to Rafiq *et al*. (2010), mulches can conserve moisture content as well as promote soil fertility which could in turn promote protein content of the grains. Boomsma *et al.* (2009) also said that availability of sufficient soil N and moisture for plants can lead to higher chlorophyll contents and photosynthesis which could produce grains with higher protein content. In another study, Mahesh (2007) reported that application of manures can significantly increase the grain protein content. Protein is one of the major requirements of the people of the developing countries like Pakistan where many people can be suffered from different health issues due to protein deficiency in their diets (Nube *et al*., 2003) which can be treated through the use of quality maize grains full of nutrition.

Table- 1. Proximate composition of maize grains treated with different mulching materials

Samples	Moisture content (%)	Crude fat (%)	Crude fiber (%)	Crude protein (%)
Farmyard manure	11	4.50	2.81	12.90
Chicken manure	9	3.01	1.49	10.37
Black plastic	10	4.19	2.36	12.25
White plastic	9	3.76	2.10	11.00
Hand weeding	8	4.18	2.19	12.50

Eucalyptus sp. (chopped leaves)	8	3.02	1.22	10.75
Weedy check	7	2.87	1.02	10.01

CONCLUSION

The present research showed significant differences in the composition of maize grains produced in the mulched treatments. Highest moisture, fat, fiber and protein contents were noticed in grains obtained from farmyard manure mulch followed by black plastic and hand weeded. As mulching is not economical in areas where maize crop is grown on larger scales, however in Khyber Pakhtunkhwa Province of Pakistan majority of the farmers owned small pieces of lands for maize sowing, so the present approach of mulching may be useful. Farmyard manure may be recommended to be used as mulch for weed control as well as for producing quality maize grains due to its easy availability and cheaper price, however, care should be taken as to avoid the chance of further weeds infestations occurrence into the maize fields due to the presence of a large number of viable seeds of many weeds in the farmyard manure.

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