Legume Research, 42(1) 2019: 114-118
Print ISSN:0250-5371 / Online ISSN:0976-0571

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com/www.legumeresearch.in

Performance of rajma (*Phaseolus vulgaris)* cultivars under organic mulches in Meghalayan Plateau of North Eastern India

Y. Marwein and Lala I.P. Ray*

School of Natural Resource Management, College of Postgraduate Studies,
Central Agricultural University, Imphal,Umiam-793 103, Ri-Bhoi, Meghalaya, India.
Received: 05-05-2017 Accepted: 12-02-2018 DOI: 10.18805/LR-3827

ABSTRACT

A field experiment was conducted at college of postgraduate studies farm during winter season of 2015-16 in Ri-Bhoi district, Meghalaya to study the effect of two different organic mulch on rajma cultivars. The experiment was laid out in a split plot design with three main plot treatments (mulching practices) and four sub-plot treatments (rajma cultivars) and replicate thrice. It was recorded during this field investigation, that the performance of weed mulch was better over maize stover and no mulch. The emergence percentage (89%) was better under weed mulching. The plant parameters, *viz.*, plant height (51.19 cm after 60 DAS), number of branches per plant (7.84 after 60 DAS), pod length (15.05 cm), dry matter accumulation per meter square (1.15 kg), number of seeds per pod (6.48) was found significantly higher for the cultivar Selection-9 over remaining three varieties. Yield of 2.37 t ha^{-1} was recorded for weed mulch, followed by maize stover mulch (2.22 t ha^{-1}) and no mulch (2.05 t ha^{-1}). Similarly, weed mulch registered highest harvest index of 41.09% followed by maize stover mulch. The average yield of Selection-9 was found to be 2.52 t ha^{-1} which was higher significantly over other three cultivars.

Key words: Organic mulch, Selection-9, Weed mulch, Yield parameter.

INTRODUCTION

To ensure food and nutritional security of the burgeoning population under the scenario of climate change, the global food production plateau trend needs an increasing momentum thus, the role of pulse crop cannot be ignored. Rajma- a pulse crop occupies an important position in supplementing low cost plant protein. The area covered in India for the common bean cultivation is 9,466 M ha, as compared to global coverage of 29,393 M ha. While its production is 4,117 M tonnes as compared to 9,129 M tonnes in the world (FAOSTAT, 2016).

The rajma varieties have been classified in two group's, *viz*., dwarf or bush types and climbing or pole types. The dwarf varieties types are Contender, Pusa Parwati, Pant Anupama, Arka Komal, Selection-9 and the climbing types are Kentucky Wonder, RCMFB-l found suitable for this North Eastern Region (NER) (Annonymous-1). Rajma is highly nutritious and short duration crop which is mostly grown during winter season and the cultivation can be taken up with suitable mulching techniques with the residual soil moisture in the paddy fallows. The *in-situ* soil moisture stress can be overcome by using different organic mulches. Mulches are used in agriculture considering *in-situ* soil moisture conservation and found beneficial in increasing yield, water-use efficiency and profitability, while simultaneously decreases weed pressure adds nutrients to the soil (Sarangi *et al*., 2010). NER continues to be a net importer of food grains even for its own consumption except some states. In spite of covering 7.9% of the country's total geographical area, it produces only 1.5% of the country's total food grain production. There is a meagre status of the production and productivity of pulse in (NER) as compared to the mainland. Hence, an agronomic trial has been taken up to study the efficacy of rajma cultivars under different organic mulches.

MATERIALS AND METHODS

An agronomic trial was carried during winter season (2015-16) at the experimental farm of the College of Postgraduate Studies, Umiam, which is located at Ri Bhoi district, Meghalaya. The soil is sandy clay loam with pH of 4.83 and organic carbon (1.96%). The trial was conducted in split plot design with three main-plot treatments (mulching), *viz.*,i) no mulch, ii) maize stover mulch and iii) weed mulch at the rate of 5 t ha^{-1} with four sub-plot treatments, *viz.*, i) Anupama, ii) Selection-9, iii) HUR-15 and iv) HUR-137 and the field experiment was replicated thrice. Plant growth parameters were recorded for emergence, plant height (cm), LAI, Dry matter accumulation per plant (g). Plant height were taken with the help of 60 cm standard scale, LAI was measured with help of CI-203 Laser Area Meter and the formula given by (Waton, 1952). Dry matter accumulation per plant was evaluated using destructive

*Corresponding author's e-mail: lalaipray@rediffmail.com

sampling method. The yield parameter like number of pods per plant, pod length, seeds per pod, seeds weight per plant and seed index were taken manually at harvest. Economic yield was recorded per square meter basis and later converted into tonne per hectare. The weekly rainfall (mm), average maximum and minimum temperature (°C) and relative humidity (%) is shown in Fig 1 and the weekly rainy day (day), pan evaporation (mm) and wind speed (km hr^{-1}) is shown in Fig 2. During the experimentation period, maximum weekly rainfall of 129.2 mm and the total amount of 325.2 mm was received during the crop-growing season.

Farm yard manure (FYM) was applied @ 10 t ha^{-1} two weeks before sowing of rajma for proper decomposition. The major nutrients nitrogen (N), phosphorous (P) and potash (K) were supplied through the chemical fertilizer urea, single super phosphate (SSP) and murate of potash (MOP), respectively. At the time of sowing, full doses of P, K and 50% of the N dose was applied as basal (recommended doses of N, P and K = 80: 60: 40 kg ha^{-1}). Rest 50% of N fertiliser was applied at pre-flowering stage through top dressing. Standard agronomic practices were followed during crop growing period and the crop was harvested at maturity. Mulching was provided to the concerned experimental plots as per requirement one day after sowing of the seed @ 0.5 kg m^{-2}. The maize stover were chopped first and then spread over the plot.

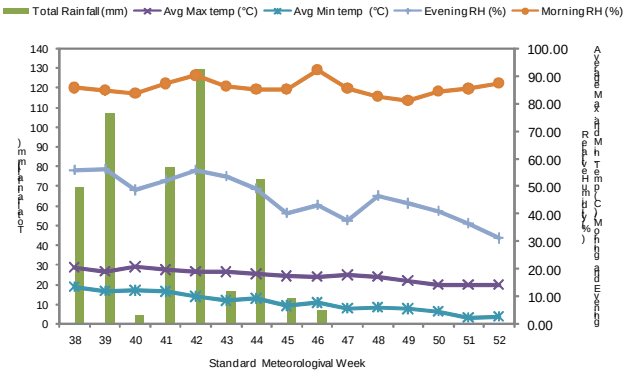

Fig 1: Weekly variation of rainfall, temperature and humidity during the crop growing period.

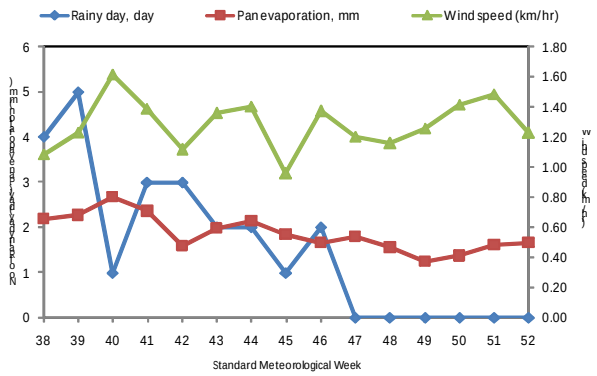

Fig 2: Weekly variation of rainy days, pan evaporation and wind speed during the crop growing period.

RESULTS AND DISCUSSION

Soil moisture: The *in-situ* soil moisture depletion pattern observed by different mulching treatment at two depths, *viz.*, 15 cm and 30 cm is shown in Fig 3 and 4, respectively. The *in-situ* soil moisture depletion pattern was found higher at lower depth, under organic mulching and no mulch condition. Similar trend in organic mulching treatments was also reported by Sinkevičienė *et al.*, 2009; Chavan e*t al.*, 2010. Due to retention and availability of soil moisture which lead to higher uptake of nutrient and resulted in higher growth of plant, as compared to no mulched condition. It is evident that mulches have double actions; one by controlling weeds and other by providing soil cover (Parmar *et al.*, 2013; Saikia *et al.*, 2014).

Growth parameters: Emergence pattern of rajma indicated non-significant difference with mulching practices. However, numerically weed mulch recorded the highest emergence value of (79.75%) as shown in Table 1. It indicates better *in-situ* soil moisture holding capacity by mulching practices. The results were well in agreements with the findings of Roy *et al.*, (2010), Nwokwu and Aniekwe, (2014). Non-significant results obtained for plant height throughout the growing period. These results were in agreement with the findings of Emam *et al.*, (2010), Prasad *et al.*,(2014). Liasu and Achakzai (2007) reported that mulching with *Tithonia*

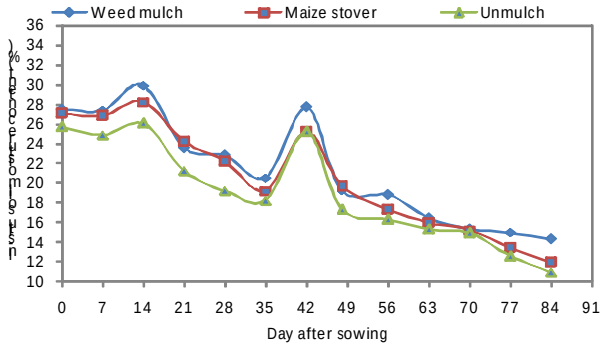

Fig 3: *In-situ* soil moisture content under different treatments plot at 15 cm depth.

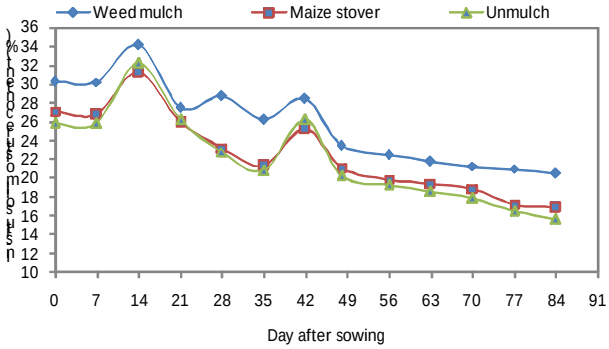

Fig 4: *In-situ* soil moisture content under different treatments plot at 30 cm depth.

Table 1: Effect of organic mulching on the emergence and growth attribute of rajma.

Treatments	Emergence (%)	Plant height (cm)	Branches No.	Dry matter (kg m^{-2})	LAI
Main plot (Level of Mulching = 03)					
No mulch	75.60	38.73	6.75	1.07	3.10
Maize stover mulch	77.50	41.99	7.07	1.04	3.03
Weed mulch	79.75	42.92	7.18	1.10	3.20
S.E.(m) ±	1.13	2.10	0.23	0.01	0.02
C.D.(P=0.05)	NS	NS	NS	NS	0.08
Sub-plot(Level of variety = 04)					
Anupama	86.57	34.62	6.84	1.14	3.17
Selection - 9	89.59	51.19	7.84	1.15	3.69
HUR -15	57.69	36.13	6.29	0.91	2.60
HUR - 137	76.59	42.93	7.02	1.08	2.98
S.E.(m) ±	2.5	1.04	0.22	0.02	0.07
C.D(P = 0.05)	7.71	3.8	0.65	0.06	0.22

Table 2: Effect of organic on the yield attribute and economic yield of rajma.

Treatments	Pod numbers	Pod length (cm)	Seed per pod	Seed weight per plant (g)	Seed Index (g)	Economic yield (t ha^{-1})
Main plot (Level of Mulching = 03)						
No mulch	16.21	12.36	5.72	24.09	34.87	2.05
Maize stover mulch	17.59	12.55	5.75	24.17	33.01	2.22
Weed mulch	17.88	12.64	5.74	25.92	34.72	2.37
S.E.(m) ±	0.60	0.44	0.07	0.34	1.71	0.06
C.D.(P=0.05)	NS	NS	NS	1.35	NS	0.23
Sub-plot(Level of variety = 04)						
Anupama	22.18	11.74	6.51	26.45	30.54	2.17
Selection - 9	20.11	15.05	6.48	29.59	34.54	2.52
HUR -15	12.43	11.11	4.93	18.86	31.66	1.93
HUR - 137	14.18	12.16	5.02	24.01	39.81	2.23
S.E.(m) ±	0.73	0.45	0.10	0.57	1.04	0.08
C.D(P = 0.05)	2.15	1.33	0.28	1.68	3.09	0.24

diversifolia leaves and fertilizer application together promoted the growth (including plant height) and development of potted tomato plants. Significant results were recorded among the four varieties throughout the crop duration, this might be due their genetic character and adaptability to growing environment (Das *et al*., 2014: Yadav *et al*., 2015) which appeared due to shortening of internodes length of the plant (Khonok *et al*., 2012). Branching is basically a genetic character but environmental conditions and farming practices also influence the number of branches per plant. The results of the present study indicated that number of branches per plant was significantly affected by varieties (Table 1). The results were well in agreement with the findings of the Pandey *et al*., (2011), Yadav *et al*., (2015) made on french bean. Leaf Area Index (LAI) was recorded higher for selection-9 throughout the crop duration and lower LAI was registered for HUR-15 (Table 2). This might due to the genetic makeup of the varieties as supported by the findings of Das *et al*., (2014), Yadav *et al*., (2015). Dry matter accumulation was found significant at 60 DAS for weed mulch (0.88 kg m^{-2}) recorded higher then maize stover mulch (0.83 kg ha^{-2}). Maize stover mulch and weed mulch treatments were found to be statistically at par as given in Table 1. This might be due to higher plant height and leaf area due to organic mulching. This result was supported by the findings of Patil e*t al*., (2011), Reddy *et al*., (2016). Mulching reduced the temperature at 0-10 cm soil depth, it also reduces soil evaporation, and increase dry matter accumulation during the growth period. Similar conclusions were drawn by Bu *et al*., (2013), Prasad *et al*., (2014). The availability of high soil moisture reduces stomatal closure; which induces the openings of the pathways for the exchange of water, carbon dioxide and oxygen, resulting in increases in photosynthetic rate (Madhu and Hatfield, 2014).

Yield attributes: The various yield attribute parameters like pod number, pod length, seeds per pod, seed weight per plant, seed index and economic yield in tonnes per hectare are presented in Table 2. Non-significant results were registered by the mulching treatments on the number of pods per plant, pods length, and seeds per pod, where, no mulched treatment recorded the lowest (Table 2) as compared to the mulch treatments. This may be due to less availability of soil moisture which leads to poor fruit setting. The reductions in number of pods per plant may also be attributed due to abscission of flowers and pods or by the failure of fertilization due to the production of unviable pollens under moisture stress conditions under no mulched plots (Ahmed and Suliman, 2010).

The availability of *in-situ* soil moisture depends on several factors, *viz.*, soil structure, texture, porosity and

external addition of mulches, which later influences the crop growth and resulting in better productivity for rajma (Marwein *et al*., 2017). Increase in soil moisture added turgidity to the cell, with better turgidity the translocation as well as transportation of nutrient takes place in a better way as compared to the stressed state. With increase in turgor pressure, physiologically photosynthetic rate also increases, which improved assimilate production and transportation from source to sink thereby increasing pod length and other yield attributes simultaneously (Al-Suhaibani, 2009; Marwein,2017).

In case of the rajma varieties significant results were recorded, where Selection-9 registered the highest pod length. Increasing the length of pod may be related with the age of the plant and its genetic characters as reported by Rashid and Hossain, (2014). Among the rajma varieties Selection-9 registered the higher number of seeds per pod (Table 2). Better control of weeds under mulch which could have also favoured to increase the yield as reported by Chinnathurai *et al.*,(2012).

Significant results for seed yield were also registered among rajma cultivars and Selection-9 outperformed other varieties. This can be due to the genotype of the respective variety which had bolder seeds, more number of seeds per pod and higher bearing capacity per plant. Similar results were also reported by Zamir *et al*., (2013), Das *et al*.,(2014), Tao *et al*.,(2015). The maximum seed index was registered for HUR-137 (39.81 g). The minimum was recorded for Anupama (30.54 g). The significant results registered for the rajma variety may be due to the genotype of the respective variety, as with relatively bolder seeds, with more number of seeds per pod. The results were in well agreement with the findings of Zamir *et al*.,(2013), Das *et al*., (2014).

The economic yield recorded for the mulch treatment was found significant (Table 2). Higher economic yield of 2.37 t ha^{-1} was obtained for weed mulch among the main treatments. Among the sub plot treatments higher economic yield was registered for selection-9 (2.54 t ha^{-1}). This could be attributed to the ability of plant to absorb the adequate soil moisture and nutrients. The availability of soil nutrients was made possible due to the presence of soil moisture in the edaphic zone of the plant as per its requirement resulting in better yield component and grain yield. Similar results were found by (Anonymous-II, 2012) in moong bean; (Karunakaran and Behera, 2013) in soybean and (Reddy *et al*., 2016) on pigeon pea.

CONCLUSION

Weed organic mulch resulted in higher values for germination and leaf area index, thereby augmenting the yield to 2.37 t ha^{-1}. Selection -9 among different cultivars of rajma proved to be significantly better. Hence, under the hilly terrain of NER where soil moisture is of great concern, practicing organic weed mulch with Selection-9 cultivar of rajma during winters cannot only increase the cropping intensity but will also supplement pulse production of the region.

ACKNOWLEDGEMENT

The authors would like to thank the Research Advisory Committee Members, Dean, College of Postgraduate Studies, Barapani, Meghalaya for the logistic help and support rendered during the tenure of the experiment. The financial support received from CAU, Imphal during the tenure of Master Degree is also thankfully acknowledged.

REFERENCES

Ahmed, F.E., Suliman, A.S.H. (2010). Effect of water stress applied at different stages of growth on seed yield and water-use efficiency of Cowpea. *North America J. of Agriculture and Biology* **8**: 215-351.

Al-Suhaibani, N.A. (2009). Influence of early water deficit on seed yield and quality of faba bean under arid environment of Saudi Arabia. *J. of Agric. and Environmental Sci*., **5**: 649-654.

Anonymous-I. (2016). Annual Report. ICAR Research Complex for North Eastern Region, Umroi Road, Umiam-793103, Meghalaya.

Anonymous-II. (2012). Annual Report. Indian Institute of Pulse Research, Kanpur.

Bu, L., Liua, J., Zhu, Luo, S., Chen, X., Li, S., Hill, R.L., Zhao, Y. (2013). The effects of mulching on maize growth, yield and water use in a semi-arid region. *Agric. Water Manage*., **123**: 71-78.

Chavan, M.L., Phad, P.R., Khodke, U.M. and Jadhav, S.B. (2010). Effect of organic mulches on soil moisture conservation and yield of *rabi* sorghum (M-35-1). *Int. J. of Agri. Engg.*, **2**(2): 322-328.

Chinnathurai, S.J., Veeramani, A., Prema, P. (2012). Weed dynamics, yield and economics of pigeonpea influenced by growth promoters and mulching. *Indian Journal of Weed Science* **44**(3): 186-190.

Das, R., Thapa, U., Debnath, S., Lyngdoh, Y.A., Mallick, D. (2014). Evaluation of french bean (*Phaseolus vulgaris* L.) genotypes for seed production. *J. Appl. and Nat. Sci*., **6**(2): 594-598.

Emam, Y., Shekofa, A., Salehi, F., Jalali, A.H. (2010). Water stress effects on two common bean cultivars with contrasting growth habits. J. *of Agriculture and Environmental Sci*., **9**: 495-499.

FAOSTAT. (2016). Data Food and Agricultural Organization (FAO) of United Nations. htm.

Karunakaran, V., Behera, U.K. (2013). Effect of tillage management and crop establishment techniques on energetic, water use efficiency and economics in soybean (*Glycine max*)–Wheat (*Triticum aestivum*) cropping system. *Indian J.Agron*., **58**(1): 42-47.

Khonok, A., Gohari, A.A., Dargah, R.E. (2012). Effect of irrigation management and straw mulch on yield of common bean(*Phaseolus vulgaris* L.). *Am-Euras. J. Agron*., **5**(3): 40-43.

Liasu, M.O., Achakzai, A.K.K. (2007). Influence of Tithonia diversifolia leaf mulch and fertilizer application on the growth and yield of potted tomato plants. *American Eurasian J. Agric. & Environ. Sci*., **2**(4): 335-340.

Madhu, M., Hatfield, J.L. (2014). Interaction of carbon dioxide enrichment and soil moisture on photosynthesis and transpiration and water use efficiency of soyabean. *Agricultural Sciences*, **5**: 410-129.

Marwein, Y., Ray, L.I.P. and Dey, J.K. (2017). Influence of mulch on depletion pattern of in situ soil moisture in Rajma (Kidney Beans) crop system of Meghalaya. *Journal of E planet*. **15**(1):55-60.

Marwein, Y. (2016). Influence of organic mulching on soil moisture and yield of rajma (*Phaseolus vulgaris* L.) varieties under mid altitude of Meghalaya. Unpublished M.Sc. Thesis. Submitted to the Central Agricultural University,Imphal. Pp 76.

Nwokwu, G., Aniekwe, L. (2014). Impact of different mulching materials on the growth and yield of watermelon (*Citrullus lanatus*) in Abakaliki, Southeastern Nigeria. *J. of Biology Agriculture and Healthcare*, **4**(23): 22-30.

Pandey, Y.R., Gautam, D.M., Thapa, R.B., Sharma, M.D., Paudyal, K.P. (2011). Variability of French bean in the western mid hills of Nepal. *Kasetsart J*., **45**(5): 780-792.

Parmar H.N., Polara, N.D. and Viradiya, R.R. (2013). Effect of mulching material on growth, yield and quality of watermelon (*Citrullus Lanatus* Thunb) *Cv*. Kiran. *Universal J. of Agricultural Res*., **1**(2): 30-37.

Patil, S.L., Sheelavantar, Shashidar, K.C. (2011). Growth and yield of winter sorghum (*Sorghum bicolor* (L.) Monech) as influenced by rain water conservation practices, organic materials and nitrogen application in Vertisols of Semi Arid Tropical India. *Indian J. Soil Conserv*., **39**(1): 50-58.

Prasad, B.V.G., Chakravorty, S., Saren, B.K., Panda, D. (2014). Effect of mulching on physiological growth determinants of productivity in french bean (*Phaseolus vulgaris* L.). *Hort. Flora Res. Spectrum*, **3**(2): 162-165.

Rashid, A.S.M.H., Hossain, M.M. (2014).Yield and quality of green pod production of bush bean (*Phaseolus vulgaris* L.) as influenced by harvesting time. *American-Eurasian J. Agric. & Environ. Sci*., **14** (11): 1221-1227.

Reddy, M., Thimmegowdda, M.N., Ramachandrappa, B.K., Herbal, N. (2016). Effect of moisture conservation practices on productivity and economics of finger millet and pigeon pea intercropping system in the dry zone of Eastern Karnataka. *e-planet*,**14**(1): 53-57.

Roy, S., Arunachalam, K., Dutta, B.K., Arunachalam, A. (2010). Effect of organic amendments of soil on growth and productivity of three common crops *viz. Zea mays*, *Phaseolus vulgaris* and *Abelmoschus esculentus*. *Applied Soil Ecology*, **45**: 78-84.

Saikia, U.S., Kumar, A., Das, S., Pradhan, R., Goswami, B., Wungleng, V.C., Rajkhowa, D.J. and Ngachan, S.V. (2014). Effect of mulching on micro-clilimate and yield of mustard (*Brassica juncea*) under mid-hill condition of Meghalaya. *J. of Agrometeorology* **16**(1): 144-145.

Sarangi, S.K., Saikia, U.S. and Lama, T.D. (2010). Effect of rice (*Oryza sativa*) straw mulching on the performance of rapeseed (*Brassica campestris*) varieties in rice-rapeseed cropping system. *Indian J. of Agric Sci*, **80**(7): 603-605.

Sinkevičienė, A., Jodaugienė, D., Pupalienė, R. and Urbonienė, M. (2009). The influence of organic mulches on soil properties and crop yield. *Agronomy Res.*, **7**(1): 485-491.

Tao, Z., Li, C., Li, J., Ding, Z., Xu, J., Sun, X., Zhou, P., Zhao, M. (2015). Tillage and straw mulching impacts on grain yield and water use efficiency of spring maize in Northern Huang-Huai-Hai valley. *The crop Journal*, **3**: 445-450.

Yadav, B.V.S., Srinivasulu, B., Reddy, P.S.S., Balakrishna, M. (2015). Influence of sowing dates on growth and yield of french bean (*Phaseolus vulgaris* L.) varieties under Rayalaseema Region of Andhra Pradesh. *J. of Agroecology and Natural Resource Manage*., **2**(2): 145-149.

Zamir, M.S.I., Javeed, H.M.R., Ahmem, W., Ahmed, A.U.H., Sarwar, N.,*et al*. (2013). Effect of tillage and organic mulches on growth, yield and quality of autumn planted maize (*Zea mays* L.) and soil physical properties. *Cercetări Agronomice în Moldova*., **2**(154): 17-26.