AgriCos e-Newsletter
ISSN: 2582-7049
Volume: 02 Issue: 06 June 2021 Article No: 32

Kaolin: A Smart Approach in Dry Land Agriculture

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SUMMARY

India`s majority arable land belongs to dry zone.In dry land agriculture, shortage of water is the major obstacle in agricultural production. Hence to get sustainable yield in such adverse conditions, it is necessary to implement various water saving techniques as well as use of different agronomical practices which can facilitate sustainable yield in such conditions. In this context, researchers and farmers both are being trying various methods to cope this serious issue. Use of PBRs, mulching practices, identification of tolerant genotypes, grafting technique and use of anti-transpirants etc. might be the solution of this condition. Amongst mention techniques, use of anti-transpirants can be rendered as a remedy against this problem. As suggested in name, anti-transpirants are used to check the water losses occurring due to transpiration. There are various anti-transpirants are available in market which can sprayed, applied as paste, wax coating. All these are meant to reduce the transpirational rate. In Spray type, Kaolin has reported maximum better results and are advisable to use under water scarcity zone.

INTRODUCTION

Dry land means the area with low soil moisture content with high evapotranspiration (Wang *et al*. 2012), whichresulted into water deficit conditions prevailing throughout the year and cultivating the food production in this environmental condition is known as dry land agriculture (Araus*et al*. 2007). About 72% of the global dryland are in the developing nations (Reynolds*et al*. 2007). In India, where 44% of the total food production being supported by dryland.Geographically, dryland agricultural area in India includes the north western desert regions of Rajasthan, the plateau region of central India, the alluvial plains of Ganga Yamuna river basin, the central highlands of Gujarat, Maharashtra and Madhya Pradesh, the rain shadow regions of Deccan in Maharashtra, the Deccan Plateau of Andhra Pradesh and the Tamil Nadu highlands(Rao and Rayan, 2004).In dry land the agriculture is depends upon the rainfall and availability of water resources are capturing & storing of waterin open reservoirs.Dry farming areas are characterized by very low and highly variable and uncertain yields. Crop failures are quit common these are mostly due to low moisture retention capacity prolong dry spells during the crop period. Inadequate and uneven distribution of rainfall results in low production. There are some remedies to lower down these conditions and one of these is anti-transpirant. Used ofanti-transpirants results to reduce the crop failures by maintaining water balance in plants.

Anti-Transpirants

Anti-transpirant is any material applied to transpiring plant surfaces for reducing water loss from the plant. There are four types of anti-transpirants reported:

Stomata closing type: Maximum transpiration occurred through stomata, and transpiration (Kramer, 1937; Cowan and Troughton, 1971; Pieruschka*et al*., 2010)from the stomata can be checked by using following chemicals Phenyl mercuric acetate (Squire and Jones, 1971), atrazine (Bagheri*et al*. 2013), abscisic acid (Berkowitz and Rabin, 1988; Agehara and Leskovar, 2012; Weaver and van Iersel, 2014)can serve the purpose.

Film forming: Plastic and waxy materials which form a thin film on the leaf surface retard the escape of water due to formation of physical barrier.Mobileaf, hexadecanol,silicone, oils,waxes are some of the film forming type of anti-transpirants (Faralli, 2017).

Reflecting type: These are white materials which form a coating on the leaves and increase the leaf reflectance. By reflecting the radiation, they reduce leaf temperature and thus reduce thetranspirational loss (Abou-Khaled*et al*., 1970).Kaolin, Diatomaceous earth, Calcium carbonate, Magnesium carbonate and Zinc sulphate are some of the examples of reflecting anti-transpirants (Chauhan, 2017).

Growth retardants: These chemicalsreduce shoot growthand increase root growth and thus enable the plants to resist drought. Cycocel (CCC) can act as an anti-transpirant (Aurin, 2014).

Kaolin: As Anti-transpirant

Kaolin is a white non-abrasive fine-grained and contains alumino silicate mineral [$Al_4Si_4O_{10}(OH)_8$] (Murray, 2006). It hasbeen purified and sized so that it acts as an anti-transpirant and easily disperses in water as well as reducing drought stress on plants.

Effect of kaolin in Soybean

Javan *et al*., 2013 tested some anti-transpirants on soybean under deficit irrigation and revealed that plants sprayed with kaolin (6%) has shown better vegetative growth with higher yield.

Effect of kaolin in Sorghum

Sorghum is one of the most important grains in the world. Although the climate is warm, it can grow in a variety of conditions. Optimal growth takes about 26-30 degrees. Sorghum is drought tolerant but less productive. In dry India, soft mulch andtranspiration agents i.e. kaolin, atrazine have been reported to reduce moisture stress, improve water utilization and loss, increase nitrogen and phosphorus, and improve grain yield (Vishal Guleria 2020).

Effect of kaolin in Brinjal

Brinjal (*Solanum melongena* L.) is one of the most important and popular vegetable plants of the solanaceae family. Proper irrigation play a major role in increasing the productivity and quality of crops.Karuppaiah*et al*., 2003 studied effect of various anti-transpirants on brinjal and expressed that plants treated with kaolin (7.5%) maintained better physiology as that of remaining ones and eventually those plants yield higher than remaining.

Effect of kaolin in Tomato

Basically tomato is one of the most important and popular vegetables all over the world. It belongs to family solanaceae. It is warm season crop but may be grown in all seasons. The positive effect on growth of tomato may be due to that kaolin foliar spray help to reduce the transpiration rate, and this in turn led to hold higher water content in the tissues of plant and this might favour the plant metabolism especially carbohydrate metabolism and many other important functions that directly influence growth of the plants. (Bafeel and Cantore *et al*.,2009).Djurović *et al*., 2016 studied influence of kaolin (5%) and control (without kaolin) under various irrigation regimes ((a) full irrigation - 100% of ETc (crop evapo-transpiration and (b) deficit irrigation (D) at 50% of Etc). From the observed results, it is clearly evident that plants treated with kaolin (5%) yielded better than that of non-treated plants.

Effect of kaolin in Sweet Pepper

Ćosić *et. al*., 2015 tested application of kaolin on sweet pepper. In unusually dry and warm sunlight, the percentage of sunburn is the highest in sweet pepper, use of 5% kaolin suspension can reduce sunburn. The average sunburn percentage of peppers treated with kaolin was about 30% lower than that of peppers not treated with kaolin.

Effect of kaolin in Mango

Mango (*Mangifera indica* L.) is one of the major fruits of Asia, which belongs to the family Anacardiaceae. There are groups of anti-transpirants*viz*., reflecting, film forming and closing. Reflecting type of anti-transpirants substances (Kaolin) that reflect the light when applied on leaves. Results increase height of graft, maximum relative water contain, minimum transpiration loss, maximum photosynthesis rate and survival percentage. (Thorat *et al.*, 2018).Chamchaiyapor*et al*., 2013 studied influence of kaolin on physiological and yield attributes of mango and found that plants sprayed with kaolin exhibited better physiology as a result of which those plants yielded much better than plants under control treatment.

CONCLUSION

Global warming and erratic rainfall are becoming greatest threats to agriculture. To get sustainable food in such conditions, it is immense to adapt some climate smart techniques which can mitigate these threats. Among these techniques, use of anti-transpirants has proven to be one of the best solution. Kaolin observed to be one of the most beneficial anti-transpirants. It is reflective type of anti- transpirant, means when it is sprayed on the leaves, it forms a whitish layer. This whitish layer reflect the sun light due to which leaves would not get heated as a result of which the transpirational rate decreases. Hence there will be less water loss from plants. This facilitates water conservation in plant tissues and support further metabolic activities. Therefore, it can be concluded that use of kaolin in dry land agriculture boosts economical production.

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