To Investigate the Effect of Microwaves Treated Water on Growth of Brassica Seeds

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Abstract*— Microwaves spans a range from 300 MHz to 300 GHz. Although these waves have been used in many electronic appliances for the welfare of human beings, they may be very harmful for living beings. The bad effects of microwaves have also been investigated for several crops. This paper investigates the effect of microwaves treated water on the growth rate of Brassica seeds. During investigations, the other control variables such as temperature, humidity, sun light and level of gases (CO_2, N_2, and O_2) were maintained constant. It has been observed that microwaved water exposed for a specific power level and duration showed better growth rate as compared to normal water for the development of Brassica seeds.

***Index Terms*: Water, Soil, Microwave (MW) and Mustards.**

I. INTRODUCTION

Microwaves are electromagnetic waves with wavelengths longer than those of terahertz waves, but shorter than radio waves. They have frequencies between 300 MHz and 300 GHz. Magnetrons were the first devices capable of generating high power microwaves [1]. They consist of a vacuum diodes consisting of circular, resonant cavities around a cathode immersed in a perpendicular magnetic field, which deflects an electron beam, producing the microwaves [2]. Microwaves are not a form of heat, but a form of energy which manifests as heat through its interaction with molecules [3]. Microwaves are increasing its presence in daily routine life of humans. The treatment of water by microwaves may introduce changes in pH and mobility of water molecules [3].

Microwaves may affect the growth of seeds and living beings. All the three parts of a seed embryo, endosperm, and seed coat are sensitive to microwaves. The embryo is the young multi cellular organism before it emerges from the seed. The endosperm is a source of stored food, consisting primarily of starches. The seed coat consists of one or more protective layers that encase the seed.

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The mature embryo consists of an embryonic root known as the radicle, an embryonic shoot, or plumule, and one or two cotyledons. The cotyledon is described as a seed leaf that stores food in the form of starch and protein for use by the embryo. An embryo of a monocotyledon (monocot) plant has one cotyledon, while that of a dicotyledon (dicot) plant has two cotyledons.Use of water with different molecular mobilities could affect drug dissolution of a dosage form and such profile of water might be modifiable using microwaves. This study investigated the effects of microwaves on water and its influences on dissolution of free drugs and drugs in calcium-cross linked alginate beads using sulphanilamide and sulphamerazine as hydrophilic and hydrophobic model drugs respectively. The water was treated by microwave at 300 w or without pre-treatment. Microwave treatment of water increased water molecule mobility and can promote drug dissolution [3].

Microwave remote sensing using satellites is an effective method for collecting global information on land surface hydrological quantities [4].

Microwave treatment of lucerne increases: dry matter content, dry matter disappearance and crude protein percentages in the digestion residues during in vitro pepsin-cellulase digestions compared with untreated samples. This study has shown that microwave treatment is beneficial, because feeding a maintenance ration of microwave treated lucerne to Merino results in significant animal growth instead of the expected weight maintenance, which was evident in the group eating the untreated lucerne. Similarly, microwave treatment of oats increases in vitro starch digestion, which should have beneficial consequences for monogastric animals such as horses [5].

Microwave emission from crops can be featured by long vertical structures. It has been examined by using experimental facts at 10 and 37 GHz which is then modeled by the Radiative Transfer Theory. The effects on the total emission from crops are estimated by means of measurements carried out on plants in natural conditions. The results are concluded by means of emission and scattering properties of the crop. The investigation of optical depth and single-scattering albedo on plant water content has been studied [4].

The effect of microwave radiation on dry soil has been studied. Five different soil samples are collected from various geographical regions of India. The waveguide cell method was employed for the determination of the storage factor and los factor of the soil. The methodology of dielectric constant for unexposed and exposed soils to microwave radiation is given and results obtained are concluded [6].

Brassica and its germination rate have been observed under various natural environmental factors [7]. Although, it is very useful food and medicinal plant [8], the effect of microwaves on its seeds has not been reported yet. Brassica appears in some form or the other in African, Indian, Chinese, Japanese, and Soul food cuisine [9].

The objective of this paper is to investigate the effect of microwaves treated water on the growth of Brassica seeds. Section 2 describes the materials used in the experiment. Section 3 explains the research methodology of the investigations followed by results and discussion in Section 4 and conclusion is in Section 5.

II. MATERIAL USED

A household type microwave of 650 w (Fig. 1); with energy at high power supplied by magnetron operating at 2450 MHz in the continuous mode, was used to carry out this study. The energy output into the microwave oven capacity was determined by measuring the rise in temperature of 100 ml of distilled water, with initial temperature 24°C in a Borosil glass beaker, placed at the center of the cavity and heated continuously at full power for 150 seconds; and can be calculated using following equation as proposed by Neas and Collins in 1988. Using this equation, the microwave oven output was calculated as 640 w (J s^{-1}).

$$P = C_p K \Delta T (\mathrm{m/t})$$

where P is the apparent power absorbed by water sample (J s^{-1}), C_p is the heat capacity of water (J ml^{-1} $^oK^{-1}$), K = 4.184 is a factor to convert thermal chemical cal ml^{-1} $^oK^{-1}$ to watts (J s^{-1}), ΔT (^oC) is the difference between initial temperature and final temperature of water, m is the mass of water (g) and t is the duration of microwave energy application.

To investigate the growth of Brassica seeds in response to microwaves treated water, a sample of agricultural soil was collected. Total organic C ranged from 4.6 to 32.9 g kg^{-1}, clay content ranged from 1.07 to 1.48 g cm^{-3} bulk density ranged from 1.07 to 1.48 g cm^{-3} and pH ranged from 4.8 to 7.5. The Brown Brassica for the investigations was purchased from the local market in Jammu, India.

III. METHODOLOGY

The experiment was designed to investigate the effect of microwaves treated water on the growth of Brassica seeds. To carry this experiment, 20 samples of water were prepared. Each sample was microwaved to different power levels of 30 w, 50 w, 70 w, 90 w and exposure duration of 30 s, 60 s, 90 s, 120 s, 150 s. The same type of soil was put in 20 pots. Ten samples of seeds were put in each pot. After proper watering using 20 samples, the observations were recorded for ten days consecutively. During investigations, the other control variables such as temperature, humidity, sun light and level of gases (CO2, N2, and O2) were maintained constant. The length of the grown plants was measured using a scale from the base of the plant to the tip (Fig. 2). The experimental setup is shown in Fig. 3.

Fig. 1. IFB smart microwave oven.

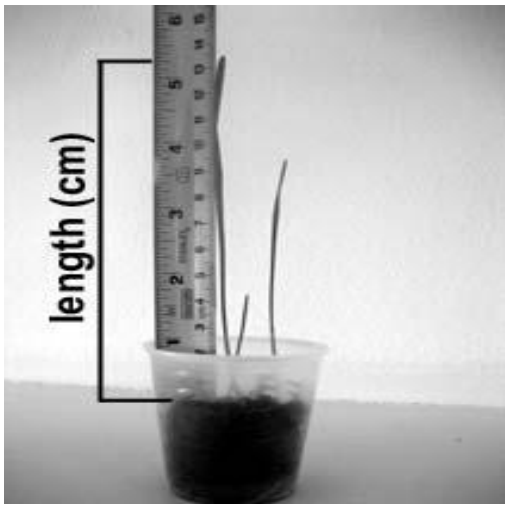

Fig.2. Measurement of plant length.

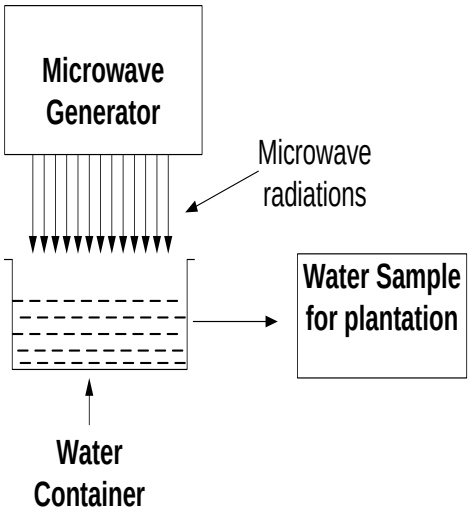

Fig. 3. Experimental setup.

IV. RESULTS AND DISCUSSION

The change in length of plants is tabulated in Tables I and Table II. These values are also plotted in Fig. 4 and Fig. 5. The analysis of the results show that the growth of plants is both power level and exposure duration dependent. High power levels and exposure durations are always harmful to the growth of the plants. Around 90 s exposure duration at 30 w power was observed as the best value for growth of the seeds.

Table I. Length of the plants after five days.

Time (s)	Power (30 w) (cm)	Power (50 w) (cm)	Power (70 w) (cm)	Power (90 w) (cm)
30	0.0	1.0	0.0	0.0
60	0.0	4.0	0.0	0.0
90	7.5	0.0	0.0	0.0
120	0.0	0.0	7.5	0.0
150	0.0	0.0	7.5	7.5

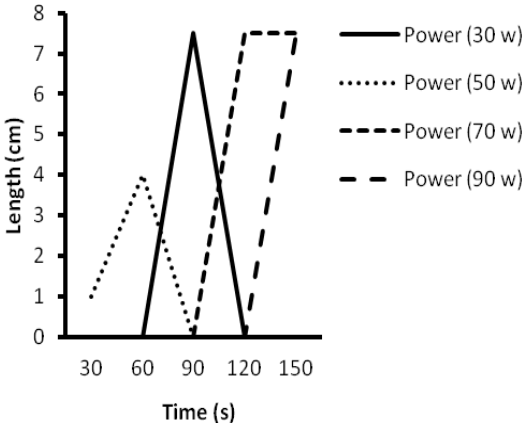

Fig. 4. Variation of growth of plants with respect to power level and exposure duration after 5 days.

Table II. Length of the plants after ten days.

Time (s)	Power (30 w) (cm)	Power (50 w) (cm)	Power (70 w) (cm)	Power (90 w) (cm)
30	0	3.1	0	0
60	0	7	0	0
90	9.5	0	0	0
120	0	0	9.5	0
150	0	0	9.5	9.5

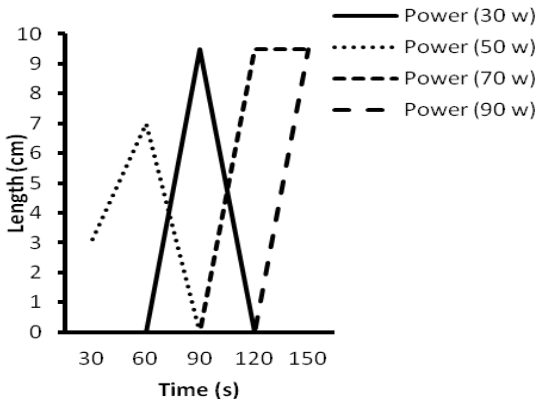

Fig. 5. Variation of growth of plants with respect to power level and exposure duration after 10 days.

V. CONCLUSION

Investigations were carried out to study the effect of microwaves treated water on the growth of Brassica seeds. The water was exposed to microwaves at different power levels and exposure durations. The analysis of the results showed that power level of 30 w with exposure time around 90 s helps in growth of the plants. The results may be useful for enhancing the crop production of these plants.

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