MACRONUTRIENT K VARIATION IN MUNG BEAN SPROUTS WITH LUNAR PHASES

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Abstract

The cosmos in atmosphere exerts variable force depending upon the relative positions of moon, sun and earth (lunar phase) and affects the plants/crops. Here, a lunar activity on sprouting of mung beans in terms of their potassium contents and sprout lengths has been tested. Under the similar mung processing in different moon phases, a rhythmic character of sprout lengths and potassium contents was observed. The statistical analysis of observations rules out the effect of moon phases on sprout lengths and predicts just randomness of the length variations. While the potassium content variations are prominent; Near New Moon, First Quarter and after Full Moon (Super Moon) phases there is rise in the contents. All this has been explained in terms of Earth’s magnetic field variations with moon phases, thereby affecting the contents of minerals in sprouts.

Keywords: Moon Phases, Mung beans, Potassium, Sprouts, X-ray Fluorescence

Introduction

Moon’s movement in an orbit around the earth affects the rise and fall of tides, air currents on the earth and occurrence of thunderstorms (Beeson, 1946; Crawford, 1989). From the ancient times, it has been believed that the lunar phases and life existing on the earth are inter-related. Time to time, the scientific community across the globe has explored this effect by conducting experiments and exploring the nature of links between the related observations. Today, it is known that there exist about 600 organisms with identified lunar periodicities either in their reproductive cycles or in their feeding periods (Endres and Schad, 2002). For more than 2000 years, farmers and craftsmen have carefully observed the moon phases while planting, harvesting or collecting plants and conducting certain forestry practices and rules are still being followed in accordance to the moon cycles (Zurcher, 1999). Steiner (1993) in his lectures on agriculture pointed out that the plants being extremely sensitive to tiny energy fluctuations in their environment are also found to respond to particular phases of the moon. In order to test the traditional lore on the subject, various scientists in the twentieth-century conducted experiments with plants and crops. There are evidences that parameters such as germination rate (Kolisko, 1936; Maw, 1967; Thun, 2003), water uptake (Brown and Chow, 1973a), root growth rate (Zurcher, 1992), tree bud morphology (Edwards, 1993), DNA formation (Rossignol et al., 1990), tree trunk expansion and contraction (Zurcher et al., 1998), crop yield (Kollerstrom and Staudenmaier, 2001), wood properties (Zurcher, 2000) and patterns of plant potency (Cole and Balick, 2010) etc. respond with the lunar phase cycle of 29.5 days. Majority of these studies have been done on the plants grown in soils and a periodical variation in rate of growth of plants was found to coincide with the moon phases.

To certify the fact that moon phases affect the growth of plants, in the present studies the process of sprouting of mung beans has been picked up as a test probe by observing sprout lengths and potassium contents in sprouts as dry seed are dormant and on soaking their dormancy ends and a new life begins. Sprouting is a nutritional phenomenon with its own enzymes. Above all, sprouts are biogenic alive and capable of transferring their life energy to a human body. Thus, to make a study on biological process, instead of growing plants in soils the sprouting of mung beans has been selected. The sprouting does not require sunshine or soil and is not limited to seasonal growth. Moreover, the time of sprouting is short and yield is high (Fordham et al., 1975). Among the seeds, mung beans with high sprouting character were selected. Since, beans are good source of potassium, so, the potassium contents have been monitored from beans to their sprouts in different phases. The details of the experiment, methodology employed for K content determinations and obtained results are being given in the following sections.

Experiment:

In the period of March - April, 2011 with the Super moon (nearest moon to the earth in 19 years that occurred on 19th March, 2011), healthy mung beans (Vigna Radiata *cv.Pusa Vishal*) were taken and cleaned by rubbing to remove the foreign materials. The whole mung seeds were soaked in water for 7-8 hours at room temperature (around 25°C), then only soaked seeds were transferred to the sprouting jar and allowed to sprout for the time corresponding to a particular moon phase (1½ -2½ days depending upon the moon's rotation, average 2 days). The processing was repeated in every phase for a synodic month of 29.5 days that is for 14 different phases, 14 sprouted samples were obtained.

In the duration of experiment, the various positions of the moon in the orbit and weather conditions on different days were also monitored as listed in table 1. The average lengths of the sprouts were measured and are listed in table 2.

Table 1 Moon's positions and Weather conditions

Day	Moon Phase	Constellation	Weather
18 March	Waxing Gibbous 98%	Virgo	Clear, calm
19 March	Full Moon 100%	Virgo	Clear, calm
20 March	Full Moon 99%	Libra	Clear, calm
21 March	Waning Gibbous 95%	Libra	Clear, calm
22 March	Waning Gibbous 89%	Scorpio	Clear, calm
23 March	Waning Gibbous 81%	Scorpio	Clear, calm
24 March	Waning Gibbous 71%	Sagittarius	Clear, calm
25 March	Waning Gibbous 61%	Sagittarius	Clear, calm
26 March	Last Quarter 50%	Capricorn	Clear, calm
27 March	Waning Crescent 40%	Capricorn	Clear, calm
28 March	Waning Crescent 31%	Capricorn	Partial Cloudy
29 March	Waning Crescent 22%	Aquarius	Cloudy, Rain
30 March	Waning Crescent 15%	Aquarius	Clear, calm
31 March	Waning Crescent 8%	Pisces	Clear, calm
1 April	Waning Crescent 4%	Pisces	Clear, calm
2 April	New Moon 0%	Aries	Cloudy, Rain
3 April	Waxing Crescent 1%	Aries	Clear, calm
4 April	Waxing Crescent 1%	Aries	Clear, calm
5 April	Waxing Crescent 3%	Taurus	Clear, calm
6 April	Waxing Crescent 8%	Taurus	Clear, calm
7 April	Waxing Crescent 13%	Taurus	Clear, calm
8 April	Waxing Crescent 21%	Gemini	Clear, calm
9 April	Waxing Crescent 30%	Gemini	Partial Cloudy, Rain
10 April	Waxing Crescent 40%	Cancer	Partial Cloudy, Rain
11 April	First Quarter 50%	Cancer	Partial Cloudy
12 April	First Quarter 61%	Leo	Clear, calm
13 April	Waxing Gibbous 72%	Leo	Clear, calm
14 April	Waxing Gibbous 82%	Virgo	Clear, calm
15 April	Waxing Gibbous 90%	Virgo	Storms, Partial cloudy
16 April	Waxing Gibbous 96%	Libra	Storms, Partial cloudy
17 April	Waxing Gibbous 99%	Libra	Partial cloudy
18 April	Full Moon 100%	Scorpio	Cloudy, rain

Table 2 Average lengths for sprouted tails

Sample no.	Average Lengths (cm)	Sampling Days
1	2.6(1)	18-19 March, 2011
2	4.8(2)	20-21 March, 2011
3	5.4(3)	22-23 March, 2011
4	4.5(2)	24-25 March, 2011
5	3.7(2)	26-28 March, 2011
6	3.4(2)	29-30 March, 2011
7	2.5(1)	31 March-1April, 2011
8	5.2(3)	2-4 April, 2011
9	3.3(2)	5-7 April, 2011
10	4.7(2)	8-9 April, 2011
11	3.6(2)	10-11 April, 2011
12	2.7(1)	12-13 April, 2011
13	3.3(2)	14-15 April, 2011
14	4.8(2)	16-18 April, 2011
Percentage Variance = 25.79		

The samples, thus sprouted, were dried directly in an oven at 100-120°C for 10-12 hours. The dried samples were preserved in desiccators to avoid the samples from moistures. The tails (sprouts) of dried samples were manually separated from the seeds. Fourteen samples each of sprouted seeds and sprouts and one of original seeds were, in turn, grinded to fine powder and pressed in briquettes of 2.5 cm dia. in a hydraulic pressing machine. The briquettes were tested for their potassium contents following the procedure given here.

Methodology:

The target of original / sprouted mung beans/sprouts was irradiated in a 90° reflection geometrical set-up with photon output of low power X-ray tube with Rh anode operated at 5 KV (Gupta et al., 2010). The obtained spectrum was recorded in Multi-Channel Analyzer MCA and compared with the standard KNO_3 spectrum, irradiated under the same conditions. On comparing the FWHM (full width at half maxima) of the two spectra (fig. 1), it was established that potassium is present in the beans. To quantify the potassium contents, the existing X-ray Fluorescence (XRF) method for thick samples (Bansal et al., 2012; Bansal and Mittal, 2009; Vandana and Mittal, 2001) with selective excitation of analyte (potassium) was followed.

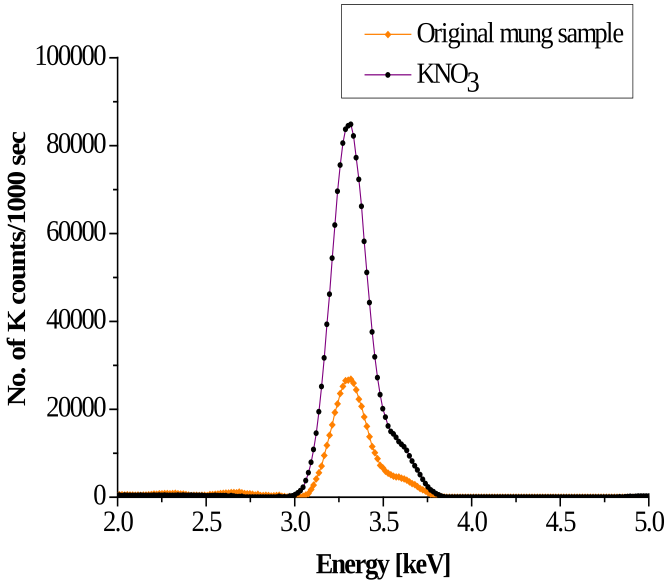

Figure 1: Background subtracted net spectra of mung sample and KNO_3 target

The method involves, in turn, selective excitation of analyte element ***x*** in sample ***S*** and in its two reference materials. First reference material is analyte ***x*** itself or its compound ***X*** with ***n*** atoms of ***x***. Second reference ***Sp*** is a mixture of ***S*** and its first reference material in known ratio. If δ' is the amount of first reference ***X*** added to the unit amount of ***S*** for ***Sp*** preparation, the amount δ is determined using formulation:

$$\delta = \frac{nM_x}{M_X}\delta' \frac{\left[\left(\frac{N_x^X}{N_x^{Sp}}\right) - 1\right]}{\left[\left(\frac{N_x^X}{N_x^S}\right) - \left(\frac{N_x^X}{N_x^{Sp}}\right)\right]} \tag{1}$$

where, M_X → molecular weight of ***X***, M_x → atomic weight of analyte ***x*** , N_x^S , N_x^X & N_x^{Sp} → counts under the analyte photo peak in ***S***, ***X*** & ***Sp*** respectively.

To determine fractional amount, δ of potassium (K) in each sample, KNO_3 and mixture of sample + KNO_3 were taken as first and second reference materials and were irradiated in the same setup. For selective excitation of potassium K X-rays in sample and two of its references, anode voltage in X-ray tube was kept at 5KV. The background correction for scattered incident photons from the target was applied with borax target in place of experimental one. The recorded borax spectrum was subtracted from sample spectrum. The counts with statistical accuracy <1% were collected under the analyte K X-ray peak in net spectrum of each sample and its two reference targets.

Typical background subtracted net spectra of second reference targets of five each of sprouted seeds and sprout samples are shown in figures 2 and 3, representing the variation of potassium contents.

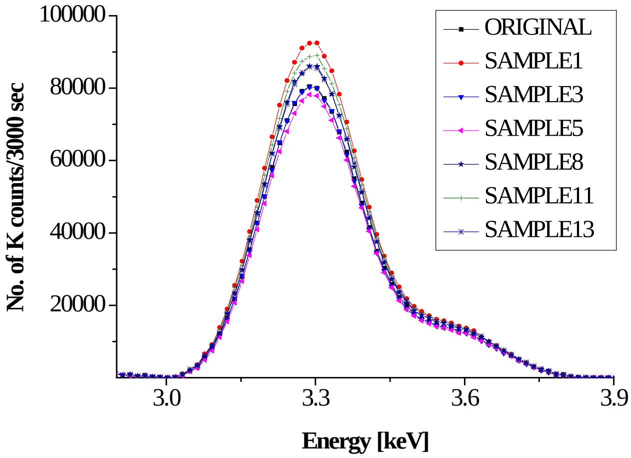

Figure 2: Background subtracted spectra of typical 5sprouted mung seed samples (showing potassium peak region)

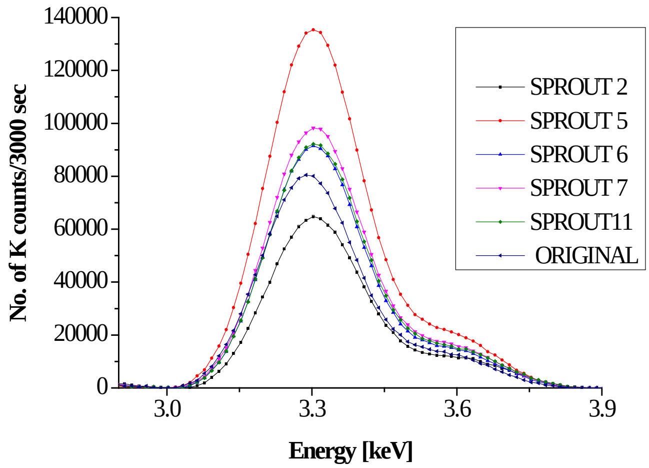

Figure 3: Background subtracted spectra of typical 5 mung sprout samples (showing potassium peak region)

Using K X-ray counts, N_x^S, N_x^X & N_x^{Sp} and the added amount δ' in relation (1), the potassium amounts in sprout beans and sprout lengths were determined and are listed in the table 3 along with their deviations from the original seed contents.

Table 3 Determined fractional Potassium amounts in sprouted mung seeds/ sprouts along with % age deviation from original seed sample (0.0110)

Sample no.	Determined fractional K content in Sprouted Mung		% age deviation from Original Seed contents	
	Seeds	Sprouts(tails)	Seeds	Sprouts(tails)
1	0.0145(10)	0.0073(5)	32	34
2	0.0108(8)	0.0371(26)	2	237
3	0.0132(9)	0.0148(10)	20	35
4	0.0122(9)	0.0120(8)	11	9
5	0.0139(10)	0.0073(5)	26	34
6	0.0118(8)	0.0243(17)	7	121
7	0.0110(8)	0.0184(13)	0	67
8	0.0103(7)	0.0110(8)	6	0
9	0.0114(8)	0.0167(12)	4	52
10	0.0112(8)	0.0083(6)	2	25
11	0.0152(11)	0.0242(17)	38	120
12	0.0085(6)	0.0101(7)	23	8
13	0.0135(9)	0.0126(9)	23	15
14	0.0102(7)	0.0142(10)	7	29
Percentage Variance	0.029	0.50	---	---

Results and Discussion

The reproducibility of the present set-up for K content determinations has already been checked with synthetic samples having substrate similar to those of plant samples[18] for percentage variance that is ~7% of the average value and is lower than the experimental errors in determined results.

The statistical analysis of sprout lengths and potassium amounts of the seeds and sprouts in terms of their variance as percentage of mean values is also being mentioned in table 2 and 3. In case of sprout lengths, the percentage variance ~26% rules out any effect of moon phases on the sprout lengths and the variations in lengths are random. For the fractional potassium contents in different sprouted mung seeds and their sprouts, the %age variance is ~ 0.03% and 0.5% respectively, which predict the observed changes in K contents are not random and are due to some forced effect. Therefore, it is apparent that even under similar processing, K contents in sprouted mung seeds and their sprouts are fluctuating with phases. Also, the variations in K contents are more pronounced in sprouts as compared to their seeds. When the rhythm of potassium, in both, is compared with moon phases, as shown in fig. 4, this rhythmicality is found to be related to moon phases. For comparison, all K variations were grouped into four groups: (a) New Moon (b) First Quarter (c) Full Moon (d) Last Quarter.

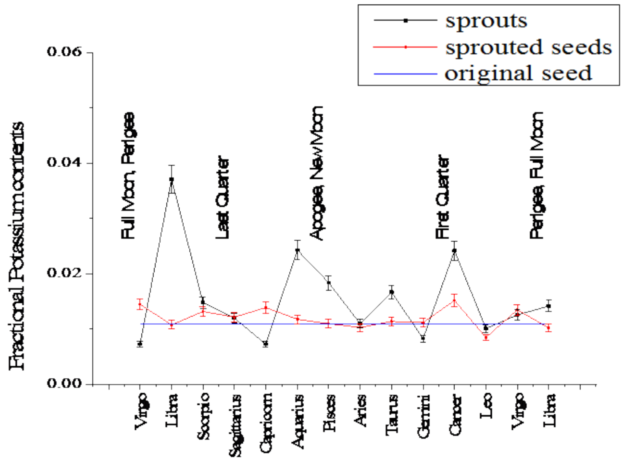

Figure 4: Plot of potassium contents in original/sprouted seeds/sprouts with Moon Phases

The observations from figure 4 are:

(1) The contents in sprouted seeds are almost constant within the error limits with slight variations in zones preceding and following the Last Quarter and the First Quarter respectively.

(2) In sprouts, the potassium uptake has shot up after the Full Moon (Super Moon) and is comparatively higher near the New Moon and at the First Quarter. The highest uptake in sprouts can be a Super Moon After Effect. While the higher uptakes in sprouts at the New Moon and the First Quarter are supported by Lai's findings (1976) as he has already reported higher uptake of potassium at new moon and first quarter in 7-day old corn seedlings.

(3) The algebraic sum of two plots (one for seeds and other for sprouts) in figure 4 gives total K of sprouted mungs equal to that of original seeds in 1^{st}, 8^{th} and 14^{th} phase of the moon, in phase durations 1^{st} - 8^{th} and 8^{th} – 15^{th}, the contents are fluctuating and the variation pattern of K in sprouts is almost similar for phases on both sides of the 8^{th} phase moon activity. Moreover, the total K in sprouted mungs results more than that of original seeds (0.0110) at certain phases. Present process of sprouting is in an isolated system of seeds, water and air; therefore, the higher K in sprouted mungs than that of original seeds looks as a biological transmutation process. Though, biological life is well explained by chemistry, but certain processes are known to occur which are beyond the reach of chemistry (Biberian, 2012) and transmutation is one of those processes. So, it may be proposed that the potassium modulation may be a result of transmutation of some other element of the mungs.

If role of climatic conditions is taken into consideration, the uptake in potassium in sprouts seems to be more for the samples collected at days when the sky was partially cloudy while it is minimum for cloudy, raining and stormy days occuring between particular moon phases.

All these observations lend support to the earlier predictions of biological rhythms for thousands of organisms (Brown and Chow, 1973b). The rhythms are reported to be influenced by natural factors. One such inescapable environmental factor is the earth's magnetic field i.e. the geomagnetic field (GMF) as reported by Belyavskaya (2004) that a biological system displays a specific magnetic life with a characteristic rhythm. He has reported that geomagnetic field (GMF) is biologically active and plants have high sensitivities towards permanent magnetic fields having strengths of GMF to lower ones. The studies revealed that MF can cause biological effects at the cellular, tissue and organ level. Therefore, explanation for present results, the fluctuations in potassium contents, may be seen in context of the varying weather and geomagnetic field due to lunar influence.

Sprouting is a biological process and involves enzyme activity, moreover, weak magnetic fields (GMF) influence the protein and enzyme activity (Kurinobu and Okazaki, 1995) and thus, the lengths' variation may be because of enzymes activity under the influence of the earth's magnetic fields. However, the enzymatic activity has been found to have a random fluctuating behaviour with changes in weak permanent magnetic fields of the order of geomagnetic field (Serdyukov and Novitskii, 2013). Thus, the random variations in the sprout lengths may be due to ooccurrence of geomagnetic disturbances of various intensities those are not uniformly distributed in lunar phase (Bigg, 1963). The effect of GF may be in terms of the change in ion movements in organs of the plant (Wojcik, 1995). Jonhson and Guy (1976); Moon and Chung (2000) pointed that MF can influence the activation of ions, polarization of dipoles in living cells. All this lends support to the changes observed in potassium contents.

The correlation between the geomagnetic factors and moon phases (Stolov and Cameron, 1964; Wulf and Nicholson, 1948) causes the dependence of the fluctuations on lunar phases. It has been found that geomagnetic storms are caused between the Full Moon and Last Quarter when the moon is within 4° of the ecliptic plane of earth's orbit around the sun, these storms greatly fluctuate the earth's magnetic field (Afraimovich et al., 2002). The relation between earth, moon and sun has been postulated by Stetson (1976), according to him, when the sun, moon and earth are in line at new moon, these three may perform like filament, grid and plate in an electron tube. Near Full Moon, the earth, in turn, would act as a grid to the moon, representing a plate. Thus, the charged particles, cosmic rays and EM radiation reflected from the moon might cast a varying effect on the earth near new and full moon. All this lends support to higher K content in Super Moon After effect and low K in New Moon phase. It is often said that moon phases affect the climate and the effect may be looked in terms of the earth's magnetic field. It has been established that clouds are formed by the cosmic rays and solar forcing, however, the mechanisms of formation remain very poorly understood (Bard and Frank, 2006) and the earth's magnetic field is known to modulate these mechanisms (Courtillot et al., 2007). As the earth's magnetic field is affected by moon, so in turn it may also regulate climatic changes and hence, plant's response.

As far as the replication of results is concerned, then it may not be pursued as the movement of moon is extremely complicated, it takes about 18.6 years (nodal cycle) to return the full or the new moon of the same month to the same apparent latitude. Kolisko's experiments (1978) on wheat and corn also showed that in some years, the moon influences were great and in some years small owing to the position of moon which varies from month to month and from year to year.

Conclusion:

The present measurements on mung bean sprouts, an isolated 2-3 days process, were found to be affected by the moon in terms of potassium nutrient of the sprouts. Sprouts are vital component of a human diet and the natural process of transmutation in sprouts gives sprouted food improved digestibility and nutritional qualities, therefore, it can be said that the moon's activity marks its influence on nutritional value of sprouts. All these outcomes are in tune with the earlier observed facts that the moon's rhythm impacts the plants grown in soil.

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