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Lunar Cycle based Cropping Calendar: Indigenous Approach of Biological Insect Pest Management

Bhagawati R.[1], Bhagawati K.[1]*, Choudahary V.K.[2], Rajkhowa D.J.[3] and Bhagawati G[4]
[1]ICAR Research Complex for NEH Region, Arunachal Pradesh Centre, Basar, INDIA
[2]ICAR-National Institute of Biotic-Stress Management, Baronda, Raipur, 493225, MP, INDIA
[3]ICAR Research Complex for NEH Region, Umiam, Meghalaya, 793103, INDIA
[4]KVK, Gossaingoan, Assam, 783360, INDIA

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Abstract

The potential role of indigenous traditional knowledge in climate change adaptation and mitigation was highly and widely acknowledged and acclaimed. The objective of the current study was to document the traditional knowledge of Galo tribes of North Eastern Himalayan region of India regarding their cropping calendar based on lunar cycle. Scientific investigation was done to validate the belief. Phenomenological approach was used to study the knowledge system and sex pheromone traps are used to study insect population and activities. Validating the traditional belief, the catches of all the three groups of insects were found to be highest in the vicinity of Full Moon and lowest in the vicinity of New Moon. It was concluded that the validated and significant knowledge should be blended with modern policies and actions to enhance their wide acceptability and success.

Keywords: Traditional knowledge, lunar cycle, pheromone, insects, crop calendar.

Introduction

Indigenous peoples and their traditional knowledge play critical roles in the collective global responses to the challenges posed by climate change. The IPCC's Fourth Assessment Report (AR4)[1] noted that 'indigenous knowledge is an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change[2]. Also, UNFCCC (2011)[3] recognizes that the conservation of traditional knowledge as it is *in situ* can be a co-benefits for ecosystem- based approaches to adaptation. The Institute of Advance Studies at the UN University recently identified more than 400 examples indicating the role of indigenous people in climate change monitoring, adaptation and mitigation[4]. Their traditional knowledge of ecosystem and their resilience to the vagaries of weather conditions are critical to building appropriate local to global responses. Despite of wide acknowledgement of traditional knowledge systems, their incorporation in the programmes and policies related to climate change mitigation and adaptation strategies are very limited[5]. How to apply this indispensable knowledge in participatory research to these new realities of climate change needs to be explored. The decision-makers must base their policies and actions on best available knowledge.

There are five types of traditional knowledge identified for climate change adaptation and mitigation- Resilient Properties, Plant Breeding, Wild Crop Varieties, Farming Practices and Climate Forecasting[6], and here we focus on Farming Practices. The underlying objective of this study was to understand local indigenous knowledge system, and to identify and strengthen their coping strategies for climate change and scale it up by blending it with modern scientific approach. The application of traditional knowledge in agricultural sector especially biological control of pests and diseases and ecological agriculture often enhances adaptability towards climate change[7]. In this study we present some significant decision making approaches of indigenous *Galo* tribes of Eastern Himalayan region regarding their cropping calendar based on lunar cycle. *Galo* tribes are indigenous community of West Siang District of Arunachal Pradesh located in North-Eastern Himalayan region of India. Their crop schedule depends on lunar cycle which influences most of their farming activities, based on nature of crops and inter-cultural practices needed. They believe that the cycle of farming activities must coincide with cycle of natural systems especially cosmic cycles for optimum production with minimum resource input. The primary concept of their belief is that the insect activities and dynamics alter with lunar cycle.

It is however important to note that not all indigenous practices are beneficial to the sustainable development of a local community; and not all indigenous knowledge can a p*riori* provide the right solution for a given problem[8]. Thus proper scientific validation and investigation must be employed before adopting any indigenous knowledge and integrating it into developmental programmes. To validate the indigenous belief, correlation study was done between the lunar cycle and insect dynamics.

Material and Methods

Study site: The indigenous knowledge was collected from farmers of *Gori, Soi* and *Bam* villages of West Siang District located in Eastern Himalayan region of Arunachal Pradesh. The research was done in ICAR Research Farm Gori, Basar, which is located at 27°58.590´ N latitude and 94°41.120´ E longitude at an altitude of 660 m msl.

Indigenous Knowledge System: To study the indigenous knowledge system, the phenomenological approach was used. The approach was chosen principally because it analyses natural behavior, as the indigenous communities perceived it rather than imposing any sort of external value judgment[9]. The Approach provides a crucial means for investigation in relation to how local people as "insider" come to know about some phenomenon[10]. The approach also helps to differentiate *noumena* (things as they are) from *phenomena* (things as we perceive them). So first hand information was collected through interactions with farmers various groups in their field. The strategy helped to gain understanding of the vitality of the indigenous methods.

The lunar cycle: The lunar cycle/phase was studied as proposed by to Nowinszky et al (2010)[11]. The phase angle values of the Moon available in various internet sites were downloaded and used for current study. The 360° phase angle of the full lunar month (lunation) was divided into 30 divisions. The division in the ± 6° phase angle value vicinity of a Full Moon (0°, or 360°) was denoted as: 0, and starting from that, divisions in the direction of the First Quarter until the New Moon were denoted as -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14. Also starting from the Full Moon, divisions in the direction of the Last Quarter until a New Moon were named: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14. The division including the New Moon was named: ±15. All divisions include 12 phase angle values.

Insect dynamics: Sex pheromone traps of most active insects, *halicoverpa armigera, spodeptra litura and fruit fly (Drosophila melanogaster)* were placed uniformly in 45 different locations (15 of each category) within the research farm (approximately area of 50 ha). Daily counting of trapped insects was done in early morning (6.00 AM). Finally the catch per day was assigned to the phase angle of the moon and average catch was plotted against each division.

Statistical Analysis: All statistical analysis and plotting was done using Microsoft Excel Software.

Results and Discussion

Knowledge System: The date of sowing, inter-cultural operations (transplantation, manure applications, weeding etc) and harvesting of the *Galo* tribes are dictated by lunar cycle. These dates are different for different crops depending upon their duration and season. They believe that by choosing crop-specific date of sowing based on lunar cycle ensures, in most of the cases, that critical stages of crop does not coincide with period of high pest activity. They believe that the insect population and activity are highest in Full Moon and lowest in New moon. They also believe that the soil moisture content usually remains high during full moon and the chances of rain increase in vicinity of full moon. So sowing of seed must be done 4-5 days ahead of Full Moon day to avoid insect infestation and facilitate proper germination. Consequently, after 10-15 days when the plant reach critical growth stage, the growth is favored by low insect activity and population as the period coincide with days near to New Moon day.

Validation: The graphs between catches of each insect and lunar cycle are depicted in figure-1, figure-2 and figure-3. In each graphs the trends are almost same. The average insect catch was found to be highest during Full Moon and comparatively lowest in New Moon. There found to be positive correlation between the insect activities and lunar phase/cycle with correlation coefficient of r=0.87, r=0.82 and r=0.86 for *Halicoverpa, Spodeptra and Drosophila* respectively.

Discussion: Moon continues to influence the daily activities of people around the world since ancient time. The impact of moon on origin and sustenance of life on earth was widely recognized and documented[12,13]. Studies suggested that the continuous cycles of wetting and evaporation along the shorelines of the early oceans due to tides caused by moon's gravitational attraction might have provided the kind of environment in which protonucleic acid fragments could begin to associate and assemble molecular strands leading to the origin of life[14]. In early Indian astronomy, moon was regarded as the mind of earth[15], controlling all the biological activities on earth. Most of the farmers throughout the world take moon into account in their works, consciously or unconsciously, related to agriculture and allied activities[16]. In Ecuador it is the general custom not to till the soil, plant seed and harvest crops during New Moon[16].

The impact of lunar phase/cycle on the insect flight activity and dynamics was well documented[17,18,19]. It was found during the current validation process that the catch in the pheromone trap for each group of insect was invariably highest in the vicinity of Full Moon day and lowest in the vicinity of New Moon day. This finding was in agreement with finding of previous study[20], where during 15 years study in Texas, the flight activities of *Helicoverpa zea* and *Heliothis virescens* found to have significant positive correlation between the catch and the percentile value of lunar illumination. The highest catch was found during Full Moon (71%) and lowest during New Moon day (9%). Also the studies on Coconut Rhinoceros Beetle (*Oryctes rhinoceros L.*) found that the activity of the beetle is more during a Full Moon[21]. However, some of the previous studies contradict our result and observed no effective difference between the catch during Full Moon and New Moon[22,23]. This may be due to other location specific environmental factors dominating the dynamics of insects. Thus our scientific investigation satisfactorily support the traditional belief system of the *Galo* tribes.

Adaptation to climate change includes all adjustments in behavior or economic structure that reduce the vulnerability of society to changes in the climate system[24]. Though climate change and global warming are global phenomenon, their impacts are very location specific. So location specific approaches are very important and need to be considered in all policies and recommendations. The policies and actions without the consensus of local indigenous people often led to poor participation and fail to achieve and realize its full potential[25-27]. Integration of indigenous knowledge into climate change mitigation and adaptation policies can lead to the development of effective and robust strategies in a very cost-effective, participatory and sustainable way[28,29]. To concludes, the traditional knowledge system must complement rather than to compete with modern scientific knowledge. Incorporation of these jwels of knowledge, preceded by proper validation, could significantly strengthen policies and recommendations for sustainable development especially under the scenario of climate change. Proper identification and documentation of traditional knowledge must be done to acknowledge and give due recognition to the traditional knowledge holder[30], beside its circulation for global co-benefits.

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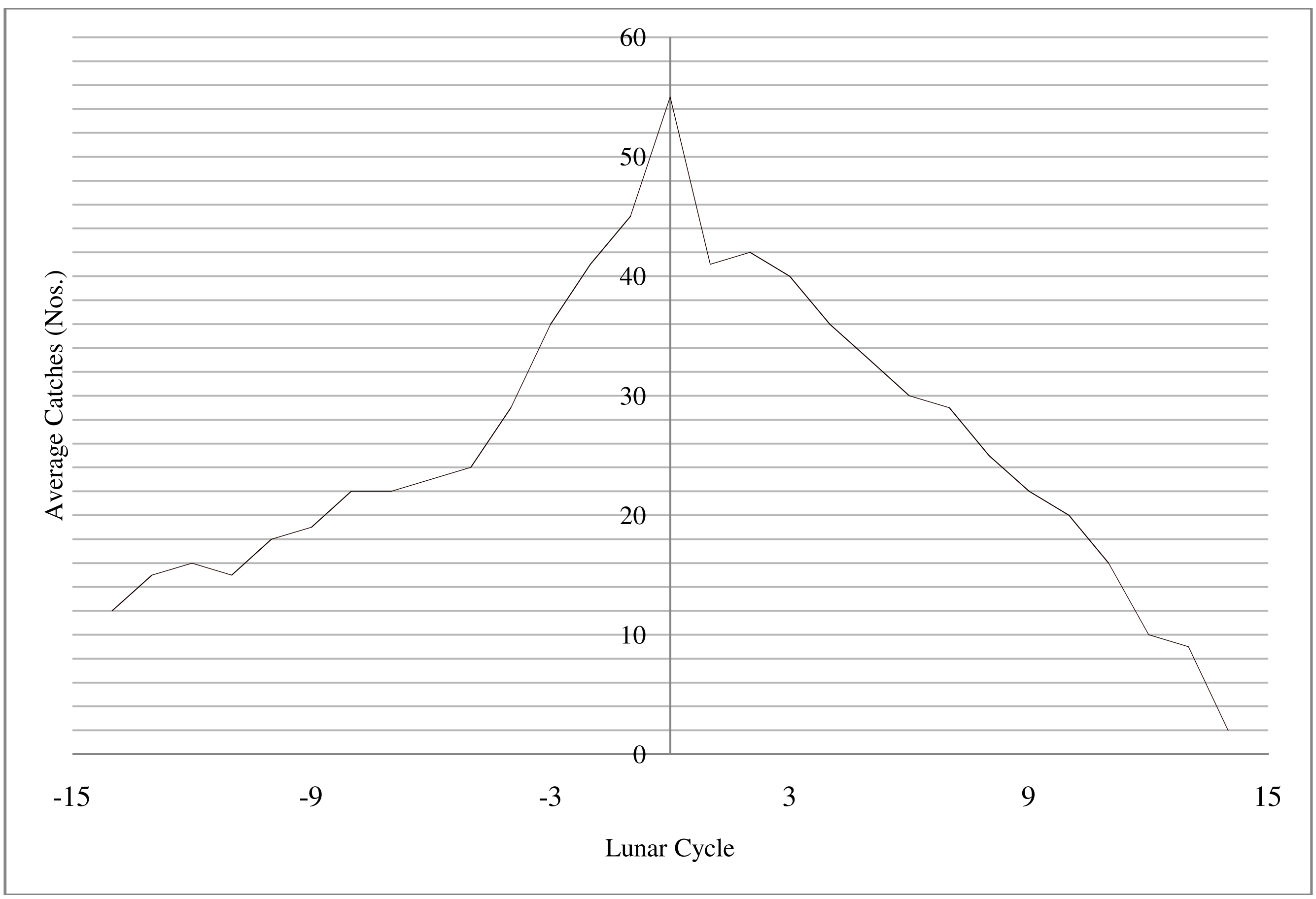

Figure-1
The average catches of *Helicoverpa armigera* during the study period (2014-15). The catches from each of the 15 traps are added and the average for each day was plotted against the lunar cycle (phase). Here -15 and 15 denotes the New Moon and 0 denotes Full Moon. The graph was made using Microsoft Excel

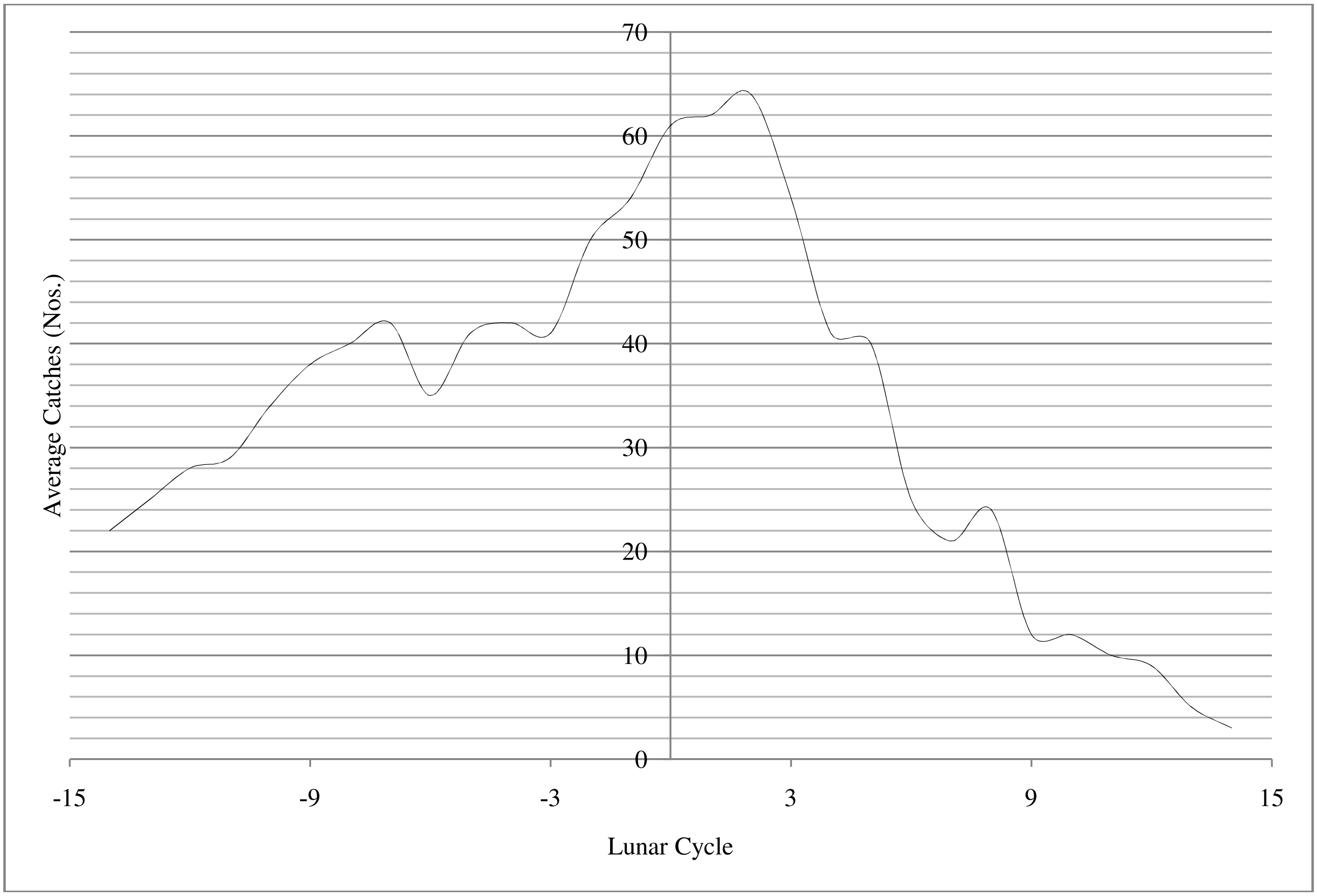

Figure-2
The average catches of *Spodoptera litura* during the study period (2014-15). The catches from each of the 15 traps are added and the average for each day was plotted against the lunar cycle (phase). Here -15 and 15 denotes the New Moon and 0 denotes Full Moon

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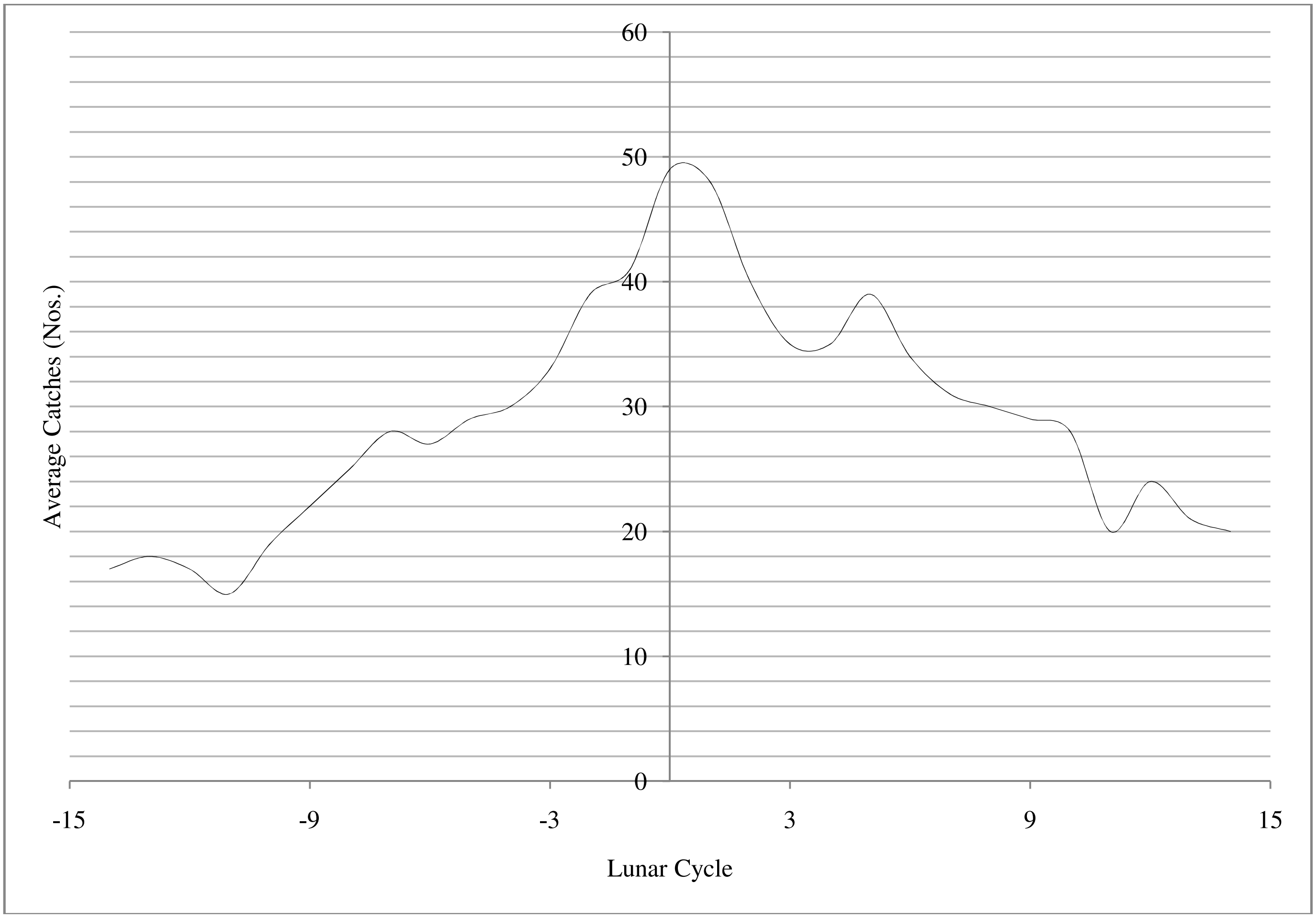

Figure-3
The average catches of *Drosophila melanogaster* during the study period (2014-15). The catches from each of the 15 traps are added and the average for each day was plotted against the lunar cycle (phase). Here -15 and 15 denotes the New Moon and 0 denotes Full Moon

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