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Humble yet significant role of mungbean in achieving self-sufficiency in pulses

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With more than 15 years' experience in research and development of pulses, Dr. Aditya Pratap has made outstanding contributions in the area of genetic improvement of pulses that include development of improved plant varieties and breeding materials through conventional and molecular breeding, development of new genomic resources, establishment of wide hybridization garden and initiating prebreeding and distant hybridization in *Vigna*. He is associated with development of 9 superior varieties of mungbean and 3 of chickpea. With a lead role in development of the mungbean varieties, he developed world's first earliest variety 'Virat' maturing in <55 days and also one of the first MABC-derived varieties of chickpea, 'Samriddhi'. His other significant accomplishments include development of trait-specific *Vigna* and chickpea donors, identification of photo-thermo tolerant *Vigna* genotypes, establishment of useful marker-trait associations, development of smartphone application tool "Mung Advisor", and molecular and morphological characterization of wild *Vigna*. He has >200 publications, 8 edited books and many awards and accolades to his credit including the prestigious ICAR Lal Bahadur Shastri Outstanding Young Scientist Award.

Pulses are the most important and indispensable component of the Indian agrarian system, both in terms of its sustainability and viability. India is the largest producer, consumer, processor and importer of pulses across the globe and therefore, these form an essential part of the life and socio-economics of the people of this country. It is heartening to note that India has made a remarkable progress in the production of pulses in the last decade witnessing a giant leap from 14.20 million tons in 2006-07 to 27.69 million tons in 2021-22, thereby witnessing a growth of 95%. The productivity during this period also increased from 598 kg/ha in 2006-07 to >930 kg/ha in 2021-22. While the contribution of chickpea (50.34%) to the total tally has remained impressive and consequently overemphasized, a definite role of a few other pulses to this remarkable feat went largely uncelebrated. Among such candidates, mungbean has been one of those pulses which created a noticeable dent by its slow yet steady increase in area, production and productivity during the last decade. Consequently, it has been a happy phenomenon that mungbean

production gained the momentum during the last about one and a half decades by witnessing a growth of 182.14% increasing the total production from 1.12 million tonnes during 2006-07 to 3.16 million tonnes during 2021-22. This was followed at a distance by chickpea (117.22%), urdbean (97.22%), pigeonpea (87.88%) and lentil (40.66%). Overall, other rabi pulses witnessed a modest increase of 24.82% during the same period, while the remaining kharif pulses witnessed a decline to the tune of -11.43%. Clearly, mungbean was a champion as it had already started its unpretentious journey of its significant contribution towards self-sufficiency in pulses.

Commensurate with the enhanced production of mungbean, the 2nd advance estimates of DAC, Government of India (https://eands.dacnet.nic.in/Advance_Estimates.htm) forecast mungbean production to a tune of 3.54 million tonnes while the target has been fixed at 4.00 million tonnes for the year 2022-23. The target is only little short of that for pigeonpea (4.55 million tonnes) for the same period which currently seems to touch around 3.66 million

tonnes as per the 2nd advance estimates, which is at a par with the 2nd advance estimates for mungbean production. Evidently, this is only marginally high in case of pigeonpea as compared to mungbean while urdbean still seems to struggle at around 2.7 million tonnes for the same period. It is notable that mungbean has risen to this status from around 2 million tonnes within last 4-5 years only, while the gains in area, production and productivity have been persistent.

This improvement is more relevant because mungbean is gaining increased importance in daily dietary requirements, especially after Covid 19 scenario. It is a significant source of plant-based nutrition, familiar for its detoxifying bioactivities and superior nutritional profile. Known for generally higher level of protein (21-31%) as compared to other pulses (18-28%), mungbean seeds contain a balanced amount of nutrients including protein, minerals, vitamins, and also dietary fibers. Mungbean is preferred in vegetarian cuisines due to a host of useful characteristics including excellent digestibility, low flatulence, richness in phosphorus, pro-vitamin-A and lysine, and significant amount of bioactive compounds. It is also low in methionine amino acid profile. Of late, there has been an increased global interest in the bio-functionality of mungbean, especially in relation to its anti-diabetic, anti-melanocyte, antioxidant, and anticancer activities. Interestingly, mungbean is one of the few agricultural commodities which can be used in myriads of diverse ways including husked/dehusked, split/whole, cooked and boiled *dal*, roasted/fried snacks, sweets and savouries, with meat and/or vegetables, incorporated in bread or cake or simply consumed as a soup or porridge. Not only it has a role in human nutrition, mungbean also has a definite role in soil conservation, soil quality amelioration, animal nutrition and secondary food processing. At the mungbean stakeholders' meet organized at the ICAR-Indian Institute of Pulses Research, Kanpur on February 10-11, 2018 having researchers, farmers, millers, food processors and people from storage industry onboard, it was concluded that direct mungbean consumption can be safely increased to upto 3 times of the present level, thanks to its multifarious uses, high nutritive value, shorter crop duration and a generally versatile growing nature.

Therefore, this is not without reasons that mungbean finds a central place in India's self-sufficiency plan in pulses, both in terms of vertical as well as horizontal expansion. Keeping in view

that it fits well in a wide array of cropping systems and crop rotations, it has been estimated that mungbean cultivation can be increased by another about 2.5 to 3.0 million ha. in India in the next 5-8 years. This includes intercropping mungbean with sugarcane (irrigated system) in western, central and eastern Uttar Pradesh and Bihar and intercropping with cotton and millets (rainfed uplands) in Maharashtra, Andhra Pradesh and Tamil Nadu; growing mungbean as a catch crop during spring/summer season in western and central Uttar Pradesh, Haryana, Punjab, Bihar, West Bengal; cultivating mungbean as a rabi crop in rice fallows in southern and peninsular India including Andhra Pradesh, Tamil Nadu, Odisha and Karnataka; and introducing it in the Kharif fallow land in Bundelkhand region of Uttar Pradesh and Madhya Pradesh. Even if by the modest estimates we are able to bring about 1.5 - 2.0 million hectares of additional area under mungbean cultivation, it will add about 1.0-1.5 million tons of additional mungbean grains to our national pulses basket even at the current productivity levels. Keeping in view the technological advancements with respect to variety and matching agro-technology development, recent policy initiatives including highest minimum support price in mungbean among all pulses and timely availability of good quality seeds through pulses seed hubs, this does not seem to be too daunting a task.

There are sufficient reasons to believe this also. As envisaged in the self-sufficiency goals, mungbean in non-traditional niches, especially in summer, spring and rice fallow areas witnessed a phenomenal growth during the last decade. Summer mungbean could be suitably grown in irrigated tracts of northern and eastern India as catch -cum - cash crop in rice-wheat rotation, canal command areas of Gujarat and Madhya Pradesh as a bonus crop and new delta areas of Cauvery basin of Tamil Nadu as an alternative crop to rice-rice system. Catalyzed by suitable varieties, the area in non-traditional niches increased impressively over the years from 6.5 lakh hectare in 2006-07 to >11.5 lakh hectare in 2020-21 while the production also increased to more than double from 2.8 lakh tonnes in 2006-07 to 6.8 lakh tonnes in 2019-20. Besides an increase in overall area and production of this wonder crop, spring and summer cultivation of mungbean has served as a confidence building measure in the suitability of our technologies and our capacity to accept the challenge of increasing overall pulses production.

Among the major drivers of an uphill movement of mungbean improvement, an impactful varietal development programme deserves mention. During the last two decades, commendable progress has been made towards development of short duration, photo-thermo period tolerant, shattering and yellow mosaic disease resistant varieties, which fit well across cropping systems in the kharif, spring and summer seasons. Development of powdery mildew resistant varieties further expanded the area of mungbean in southern states. Since 1987, 123 varieties of mungbean have been developed under umbrella of All India Coordinated Research Project while 35 varieties have been developed only in the last 10 years. It is further interesting to note that many of these varieties have been developed for more than one season and multiple agro-climatic zones, indicating the maturity of the varietal development programme in mungbean. Varieties such as Virat have been developed most recently which is the first shortest duration and pan-India variety of mungbean. Nevertheless, it is also a harsh reality that only top 10 varieties contribute to >80% in national seed indent while rest all contribute only <20%.

A few varieties will be remembered for contributing prominently in this silent mungbean revolution. The landmark varieties such as Samrat, SML 668, IPM 02-3, IPM 99-125, GM 4, IPM 2-14, Pant Moong-5, HUM 16 ruled the national seed indent till the second decade of this century. These were gradually replaced by the new, shorter duration and multiple disease resistant varieties such as Virat, Shikha, Soorya, MH 421, etc. in the later part of the second decade and continue to rule till date. New and useful trait-specific donors were identified, shared and deployed in introgression breeding while wild genetic resources and exotic germplasm were procured, evaluated, characterized and deployed for introgression of desirable traits hitherto not found in cultivated materials. Interspecific hybridization, especially mungbean x urdbean introgression also led to development of many improved varieties of mungbean, for example, KM 2241, HUM 16, MH 2-15 and TMB 37, and a few of these became highly popular among the farmers within a short period. IPM 02-3 was developed using IPM 99-125 and Pusa Bold 2 and it was recommended for both Spring and *Kharif* seasons. IPM 2-14 is another such highly promising variety which has been released

for spring cultivation in South Zone of the country and has gained tremendous popularity.

International cooperation also materialized emphatically in mungbean research during the last few years. Establishment of 'International Mungbean Improvement Network' in the year 2016 was a long awaited step towards consolidating the global research efforts towards genetic improvement of this precious pulse crop. Funded by the Australian Centre for International Agricultural Research (ACIAR), the 1st phase of this network (2016-21) was partnered by researchers from World Vegetable Centre (WorldVeg) Hyderabad and Taiwan, ICAR-IIPR, Kanpur, Department of Agricultural Research (DAR), Myanmar, Bangladesh Agricultural Research Institute (BARI), Bangladesh and Queensland Department of Agriculture and Fisheries, Australia. Subsequently, the network was further expanded in its second phase (2022-26), the Legume and Tuber Crops Research Institute, Indonesia and Agricultural and Livestock Research Organization, Kenya joining the network officially, and many other organizations/researchers joining the network informally. Within a span of only about 6 years the project has yielded ample dividends as it has eased the exchange of some of the best materials including the minicore accessions, advanced breeding lines and most popular varieties among the partner countries, triggering development of new breeding material utilizing germplasm from diverse sources and product profile development by respective partners, thereby strengthening the combined research efforts towards mungbean improvement. Establishment of a network on 'Genetic enhancement of minor pulses', funded by Department of Biotechnology, Government of India, is another such multi-institutional initiative which deserves appreciations. The network has undertaken massive efforts towards genome sequencing and resequencing of genotypes, development of genetic and genomic resources, and new breeding materials not only in mungbean but also in other related pulses. More such multidisciplinary and multi-institutional research efforts are required to make this crop an international commodity. While mungbean has already established itself as a humble driver of pulses revolution in India, it is sure to play an essential role in future also and therefore deserves due recognition, investment and research focus in times to come.