Citation of papers vis-à-vis quality of research in agricultural sciences

This is with reference to the article 'Uncitedness of Indian scientific output' by Garg and Kumar[1]. Efforts of the authors are praiseworthy for taking up a tremendous task of analysing such a large number of papers (35,640) published by Indian scientists in different journals during 2008. The findings have revealed that as many as 6231 (17.5%) papers remained uncited during the period 2008–2013. Further, the highest proportion of uncited papers (38%) was from agricultural sciences. After going through this article, we give here some views from the perspective of an agricultural scientist with regard to the situation in agricultural sciences.

Relatively low/no citation of papers in agricultural sciences does not mean that the research output in the field is of poor quality, though there is no denying the fact that the citation of research output is important for promoting a good publication. But, the quality cannot be judged merely on the basis of citation index. Publications depend on the mandate of an institute and the objectives of the project on which a scientist is working. The agricultural universities and institutes of the Indian Council of Agricultural Research (ICAR) have altogether a different mandate from that of the basic biological, chemical or physical sciences having academic value and/or non-agricultural applications. In the agricultural universities/ICAR institutes, emphasis has to be given on development of products and technologies for improvement in agriculture production so as to meet the food security, feed and fibre requirements of the country and uplifting of the farming community. The research mandates of agricultural universities and ICAR institutes mainly focus on applied aspects to find workable solutions to the problems faced by the farmers. In view of the agro-climatic diversities, the major research focus, therefore, is to develop technologies for local adaptation which are not published in high-end journals. The mandate is very much different from fundamental and high-end sciences which concentrate generally on basic aspects in a laboratory-oriented work environment.

When a good crop variety/technology is developed by an agricultural scientist, sometimes, only a 2–3 page research note describing its important features is published in the local journal or as a bulletin, which generally may not be widely read and cited by the other scientists; hence, there is no reflection of the same in the scientific literature. However, the variety/technology may be widely adopted by the farmers over large areas. Often the new agricultural technologies developed are published in a 'package of practices' by the university/institute, which is widely read and followed by the farmers to grow their crops. While research in basic disciplines is generally carried out under controlled environment, the applied agricultural research is conducted under variable farm and weather conditions. Hence, it does not mean that such research output is of poor quality. Some examples are given below:

(1) The bread wheat variety PBW 343 was developed by the scientists of Punjab Agricultural University (PAU), Ludhiana in the year 1995. It became so popular among the farmers that within 3–4 years, it was cultivated on as large area, about 6.5 million ha, in different states in the Indo-Gangetic Plains and gave huge economic returns to the farmers. However, only a two-page research note on this variety was published in the PAU journal[2]; it may not have been cited in many publications.

(2) PAU scientists also developed the first grain pearl millet hybrid HB 1, first single cross maize hybrid Paras, first gobhi sarson (*Brassica napus*) hybrid PGSH 51, short-duration varieties of mungbean G 65 and SML 668, first fodder maize variety J 1006, first leaf curl virus-resistant cotton hybrid LHH 144, and first muskmelon hybrid Punjab Hybrid that have been widely adopted by farmers in other states as well. All these not only played a great role in farmers' economy, but also changed breeding approaches, particularly in pearl millet and maize.

(3) PAU has also done outstanding work in introducing new cropping systems. The examples include development of early maturing varieties of mungbean (for spring season) and cotton (that enabled cotton–wheat double cropping). In case of sugarcane and maize, cultivation of these crops was introduced in non-traditional season, e.g. sugarcane in autumn and maize in winter/spring. The technology package for cultivation of maize during non-traditional winter/spring seasons was developed and recommended to the farmers in Punjab in the 1980s. With the adoption of this technology, the area under spring maize in the state has considerably increased to 30,000 ha over the years. The technology, being of local importance, had to be compiled in the form of a bulletin[3] and hence it did not get wider circulation and citation.

(4) Likewise, technologies for integrated pest management in cotton, sugarcane and maize, cropping systems approach, zero tillage, laser land levelling, net-house cultivation of vegetables during off-season, etc., developed by the PAU

Table 1. Comparison of productivity of wheat, rice and maize

State	Cropping intensity 2010–11	Wheat (kg/ha) TE* 2003–04	Wheat TE** 2012–13	Wheat Change	Rice (kg/ha) TE* 2003–04	Rice TE** 2012–13	Rice Change	Maize (kg/ha) TE* 2003–04	Maize TE** 2012–13	Maize Change
Punjab	190	4313	4838	525	3583	3856	273	2580	3785	1205
Bihar	121	1912	2194	281	1469	1837	368	2377	2705	328
Gujarat	137	2361	3015	654	1534	2044	510	1806	1640	–166
Madhya Pradesh	146	1625	2198	573	862	1298	436	1919	1511	–408

*TE, Triennium comprising 2001–02, 2002–03 and 2003–04. **TE, Triennium comprising 2010–11, 2011–12 and 2012–13.

scientists, have helped raise productivity of crops through efficient use of natural resources, but these were mostly published in local journals.

The contribution of technologies developed by PAU is more than evident from a comparison of productivity levels of three principal crops, namely wheat, rice and maize with other states (Table 1).

Punjab has achieved high levels of productivity in these three major crops under intensive agriculture (cropping intensity of 190%). It continues to march ahead on the productivity front in the 21st century. This has been made possible due to the development of high-yielding varieties and matching production and protection technologies developed by the agricultural scientists. So, it is not only the publications which are important, but the contributions/impact of technologies (that may not have been published in high-ranking journals) are equally important and need to be given due credit.

In brief, citation is an important index of quality of research work, but it cannot be applied blindly across disciplines. The citation of papers in agricultural sciences could not be compared with other sciences (basic biological, chemical or physical sciences) due to different research priorities in agriculture, which have the main focus on product development that should have direct relevance to the farming systems. Practicability of research experiments is given more favour and consideration over the outputs of merely academic nature. Wide-scale adoption of the technology by the end-users is more important than high citation of the publications based on this technology. In this light, where Garg and Kumar[1] have done an important task, we feel that low/no citation of papers in agricultural sciences is not an index of quality of research in this area.

1. Garg, K. C. and Kumar, S., *Curr. Sci.*, 2014, **107**(6), 965–970.
2. Nanda, G. S., *J. Res. Punjab Agric. Univ.*, 1998, **35**(1–2), 122–123.
3. Khehra, A. S. and Dhillon, B. S., *Breeding Maize for Cultivation in Winter*, Punjab Agricultural University, Ludhiana, 1984, p. 49.

B. S. DHILLON*
T. S. THIND

Punjab Agricultural University, Ludhiana 141 004, India
**e-mail: dhillonbaldevsingh@gmail.com*

Information and communication technology for effective integrated pest management

The launch of the World Wide Web in 1991 revolutionizing global information system[1] and National e-Governance Plan[2] of 2006 followed by the Digital India project[3] of 2014 to transform India into a digitally empowered society, facilitate wider dissemination of knowledge and technological products and processes for inclusive development of our nation. In agriculture, 25%, 5%, 15% and 50% yield loss in rice, wheat, pulses and cotton respectively, due to insect pests has been reported[4]. All studies in pest management, be it basic or applied, involve the process of collecting and recording data on pest occurrence, abundance using sampling plans and observation procedures devised based on the behaviour of the study organisms and the crops they are associated with. Pest surveillance has the components of survey and monitoring for use in pest risk analyses, establishment of pest-free areas, preparation of region and commodity-based pest lists and field-level pest management[5].

Integrated pest management (IPM), being inclusive with nutrient and holistic crop management, and knowledge-intensive requires timely processing of temporal and spatial information gathered out of e-pest surveillance for quicker need-based management actions to be disseminated by the extension functionaries for adoption by farmers. Information and communication technology (ICT) allows not only assimilation of database on pests over time and space, but also quickly processes data to facilitate a decision on pest management using the available knowledge base and critical inputs that can be mobilized and adopted for plant protection on an area-wide basis.

The Indian Council of Agricultural Research (ICAR)-based National Research Centre for IPM has been using ICT as a vehicle for launching IPM through e-pest surveillance vide its website: http://www.ncipm.org.in/. The ongoing programmes, viz. (1) crop pest surveillance and advisory project (CROPSAP) across crops of rice, soybean, cotton, pigeonpea and chickpea, and (2) horticulture pest surveillance and advisory project (HortSAP) for banana, mango, pomegranate, Nagpur mandarin, sweet orange and sapota are successful examples for large-scale area-wide implementation of IPM across Maharashtra. On-line pest monitoring and advisory services (OPMAS) for cotton are being implemented with the support of 16 co-operating centres of state agricultural universities, ICAR and *Krishi Vigyan Kendras* across 10 major cotton-growing States of India.The highlight of the programmes is the digital delivery of the pest management advisories to the farmers as short message service. Impact analyses have shown increased socio-economic benefits and absence of pest outbreaks. National Innovations on Climate Resilient Agriculture (NICRA) on pest dynamics in relation to changing climate is a strategic-cum-applied research programme, wherein ICT for pest surveillance has been used as a tool for real-time database development on pests and weather through electronic networking of identified locations from different agro-climatic zones of the country for rice, pigeonpea, groundnut and tomato, and offers web-enabled pest forecasting for major pests and select locations.

Integration of ICT for IPM implementation in our country is simple. The requisites for ICT-based pest surveillance include: (i) an organized sampling plan for selection of fields; (ii) scientifically based sampling methodology for pests, including the monitoring tools (global positioning system device, traps and lures for insects, data sheets (books));