IPM – Sticking to the Challenge

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Introduction

Cotton integrated pest management (IPM) is a constantly evolving approach to managing insect and mite pests in cotton. The goal of IPM is to integrate all means of managing pest populations with the aim of reducing insecticide use whilst maintaining profitability (IPM Guidelines, 1999/00). The Australian cotton crop is subject to a range of pests that often show a wide range in abundance between seasons. Whilst a number of new relatively selective chemical control products have become available the increasing scrutiny on chemical use by regulators has made application of some chemicals, both new and old, very difficult. This has provided a strong motivation to use more environmentally friendly insecticides and to reduce overall insecticide use. The rapid adoption of the 'new' chemistry by growers and consultants is reflected in an increasing awareness of the value of beneficial insects in the Australian cotton agroecosystem.

Cotton IPM in Australia is not easy, indeed pest management in cotton has not been easy since the single tactic of programming Synthetic Pyrethroids began to fail in the early 1980's. Insecticide resistance and environmental impact are the legacy of over reliance on a limited number of control options for heliothis. Resistance, increasing insecticide costs and the need to reduce environmental pollution are driving the continual development of a management approach that seeks to combine all the 'tools and tactics' available to growers and consultants to deal with multiple pest species in various combinations. The objective of IPM is to use all the tools in the toolbox in a way that creates a balanced approach that results in an overall reduction in pesticide use, hence reducing environmental problems and resistance while maintaining profitability. Successful cotton IPM in Australia takes a commitment to planning so that all the tools and tactics that are available can be used effectively.

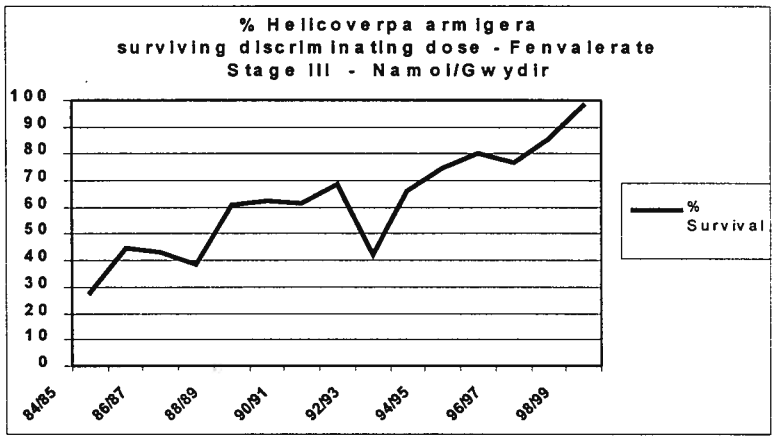
Why IPM?

As an industry we can no longer ignore the enormous pressure to reduce the impacts of chemical use in cotton. The respective government agencies through a range of legislative instruments is challenging our industry to keep pesticides well away from people, the environment and other industries (communities, creeks and cattle).

Our ability to define an IPM program for Australian cotton has improved in parallel with the introduction of new technologies, both less disruptive chemistry and insect resistant transgenic plants. These recently introduced technologies have allowed management of crop damage while preserving and encouraging a diverse range of predatory and parasitic insects that can assist the control of pests and help to reduce the need for pesticides. Many growers are now commercially practicing their former vision of pest management, some of these growers now have a new vision of a pest management program that involves collaboration with their neighbors and the strategic use of selective chemistry and are working towards implementing it.

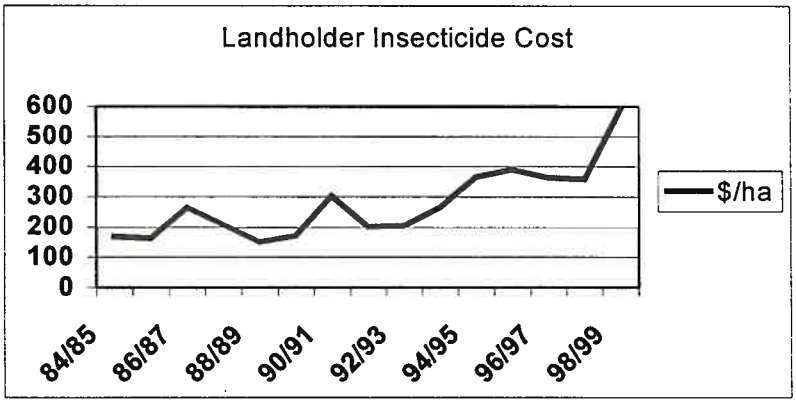
The understanding of IPM within the industry has broadened and deepened as traditional tactics are combined with the new tools. There is now a clear recognition that IPM involves a more strategic approach which requires year long planning and action (IPM Guidelines, 1999/00). Many of these tools and tactics can deliver greater benefits to the industry when deployed in a coordinated way. This is increasingly reflected in the development of regional and district area-wide management strategies.

Figure 1. Average pyrethroid resistance levels in *Helicoverpa armigera* in Stage III of the Insecticide Resistance Management strategy for the Namoi and Gwydir valleys of Northern New South Wales. Source: Neil Forrester and Robin Gunning.



Insecticide resistance and escalating costs of pest control are primary drivers for changes in pest management, the similarity of the trend in insecticide resistance to the Synthetic Pyrethroid chemical group (Figure 1) and the cost of insecticide control (Figure 2) over the last 15 years is unmistakable. The average insecticide cost has doubled in the last 10 years along with the level of heliothis resistance to pyrethroids. Concern about the ability to control our major pest has resulted in an increase in pesticide use and consequent increases in resistance to other chemical groups. The approach of utilising the next most cost-effective tool as a tactic against heliothis has come at a high price and should serve as a warning for emerging resistance problems in aphids and mites.

Figure 2. Insecticide costs in Michael Boyce & Co. Cotton Comparative Analysis of cotton growers (Landholders) in Northern New South Wales (1984 – 1999). Source: Michael Boyce & Co., Chartered Accountants, Moree.



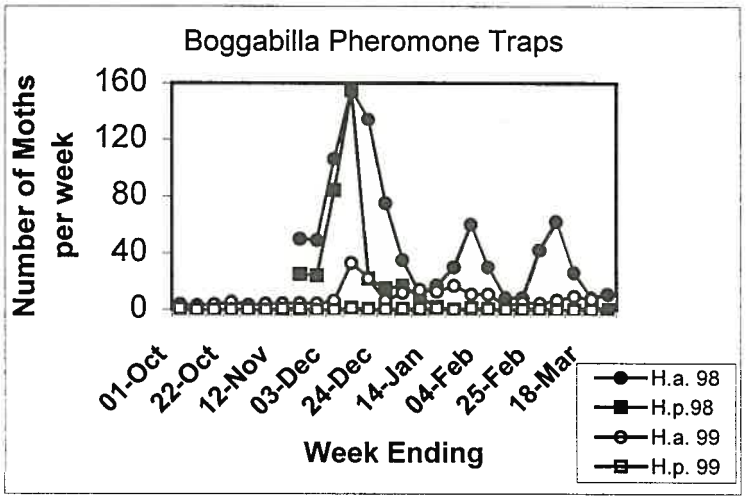
Can IPM help?

The high economic and ecological cost of over reliance on individual pest management technologies is reflected in the unacceptable endosulfan residue contamination of cattle during the 1998/99 season. The response by regulators is to further restrict the conditions of use on both traditional (through review) and recently registered chemicals. In recent years financial, resistance, environmental and regulatory pressures are threatening the sustainability of our industry. Simply reducing pesticide use will not provide a solution to these problems without impacting long-term viability. What is required is a deeper understanding and adoption of all the available tactics to control insect pests not just reliance on substituting new chemicals for old.

Australian Pest Pressure – planning for plagues

Two outstanding features of pest management in Australia are the variation in pest species and density with each new season. Pheromone trap data from Boggabilla (Figure 3) shows the dramatic difference in the level of heliothis in the Border Rivers region over the last two seasons. Secondary and occasional pests can occur in numerous combinations due to changing seasonal conditions further complicating pest management options.

Figure 3. Weekly pheromone trap counts (15) at Boggabilla for *Helicoverpa armigera* and *Helicoverpa punctigera* for 1998/99 & 1999/00. Source: Boggabilla Irrigation Landcare Group.



The challenge for pest managers is to become aware of the particular seasonal adversity and how they will react well before they are faced with the pest control decision and not to manage last years problems this year. The cotton IPM Guidelines are a decision support tool that highlight pest management considerations throughout the annual cropping cycle. The CottonLOGIC program produces objective interpretation of insect and plant monitoring data including support of multiple pest thresholds. Discussion of the pest management program and utilisation of research based decision support between consultant and grower prior to the season will contribute to quality pest control decisions when they need to be made.

Challenges for growers adopting IPM

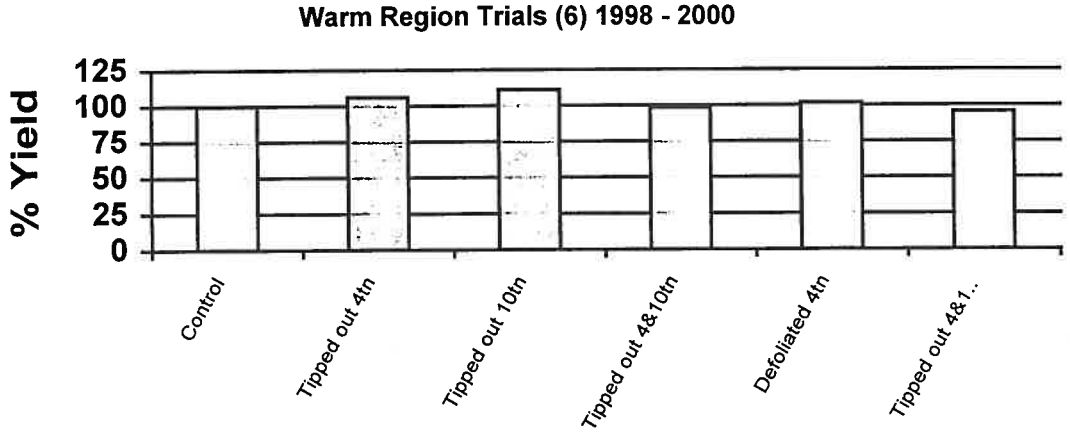
The adoption of IPM requires an attitudinal change to the traditional approach of 'see pest - spray pest'. Often the most difficult pest management option of all is to decide to do nothing, especially when this involves

relying on something that is difficult to observe or measure. The key challenges to the implementation of IPM programs in cotton involve things that are not easy to see or count.

Plant compensation – believe it or not!

Compensation for early season plant damage is not a new concept in cotton pest management, though it may seem so after the push towards total plant protection in the 1980's. The 'perfect plant' syndrome has been shown to lead to unnecessary spraying many times. The Cotton CRC extension team members have allocated a high priority to the completion of plant compensation demonstration trials at a number of sites over the past two seasons. The results of these trials (Figure 4) indicate that in warm season areas pre-squaring cotton can tolerate considerable early damage, without affecting yield or maturity penalties, from thrips, mirids or heliothis. Confidence in the ability of the plant to compensate will lead to a reduction in early season sprays which in turn will assist the preservation of beneficial insects.

Figure 4. Early season artificial plant damage trial results (incorporating terminal and leaf removal treatments at nodes 4 and 10) over two seasons 1998/99 and 1999/00. Source: James Quinn, CRC Industry Development Officer, Moree, 2000



Preserving predators and parasites

The Predator/Prey Ratio developed by Dr. Robert Mensah is a useful decision support tool for weighting the relative value of both beneficial insects and pests observed in the crop. It allows predators to be directly factored into the decision making process. Using the ratio requires time to carefully monitor certain common beneficial insects.

Many other beneficials are highly mobile, especially heliothis parasites, and may be unseen at the time of scouting. Sampling under unsprayed (INGARD®) refuges in the 1999/00 season in the Macintyre valley found that over eighty percent of pupae were parasitised (Colin Tann, pers.comm.). Preserving beneficial insects is an important component of IPM but to develop a commitment to this we need to build confidence in their value through effective monitoring.

Pyrethroid drift - silent summer

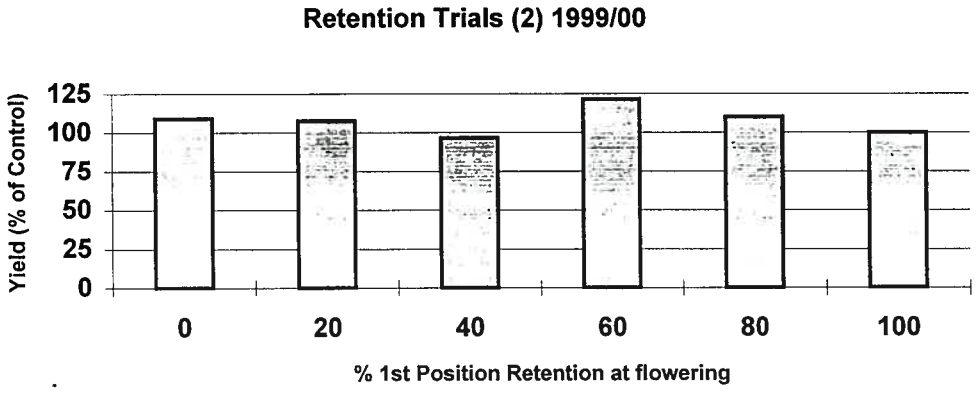
There is ample anecdotal evidence throughout the industry to indicate the commencement of spraying with Synthetic Pyrethroids (SP's) in cotton areas results in a dramatic decline in the beneficial insect population. This has also been associated with a reduction in efficacy of some biological and chemical control options. It has been a source of frustration to many IPM practitioners to the point where one of the main objectives of many area-wide groups is to avoid pyrethroid use for as long as possible. The removal of SP's from Stage I of the Insecticide Resistance Management (IRM) Strategy in 1998 was an important contribution to Australian cotton IPM. Further delay in the commencement date for SP's may be possible with the registration of new products and would assist the development of IPM programs.

Retention – how low can we go ?

The industry recommended threshold for first position square retention at flowering is 60%. Over the past two seasons there have been many instances of crops with less than ideal retention at flowering producing very acceptable yields with little delay in maturity. It can be a 'rocky road' over the six weeks to the final retention at flowering and we certainly need to be aware of the potential for rapid square loss from mirids in this period, but to maintain a minimum of 60% retention can be difficult. Demonstration trial work in recent years is challenging our view of the role of first position retention.

The Cotton CRC extension team members have allocated a high priority to the development of first position retention demonstration trials at a number of sites last season. The results of 2 of these trials (Figure 5) suggest that first position retention by itself, does not have a significant impact on yield. A negative impact of low retention on yield is likely to result from an interaction with other factors. Research on plant compensation by Tom Lei and Lewis Wilson, of the Cotton CRC will quantify this.

Figure 5. Yield of Gwydir Valley retention trials represented as percentage of control treatment (Control treatment equals 100 % first position square retention at flowering)



Source: James Quinn, CRC Industry Development Officer, Moree, 2000

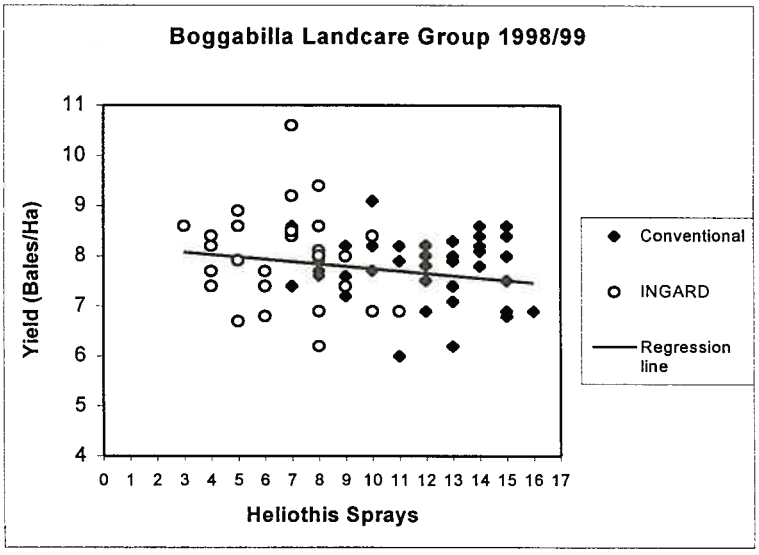
When secondary pests are the primary concern

The 1998/99 season was notable for both the number of pest species and the level of pressure. Although tipworm, mirids, aphids and mites were abundant, heliothis was the primary spray target in the majority of applications. In the 1999/00 season, for many INGARD® crops in the Macintyre, the majority of sprays were not for heliothis. Our ability to manage heliothis selectively in INGARD® crops will enhance IPM programs through the preservation of predators and realise more of the promise of this technology to reduce insecticide use. However, pests currently considered as secondary or occasional such as aphids, mites, green vegetable bug and possibly whitefly are becoming more common. This is partially due to the imperative to reduce endosulfan use to avoid off-farm contamination of creeks and cattle. Pest managers need to be aware that the suppression of secondary pests previously afforded by endosulfan may no longer exist and allowance should be made for more vigilant monitoring. Some of these pests will prove troublesome, particularly where broad-spectrum chemicals are the only registered control options.

Assessing IPM spray programs

Analysis of a number of field data sets (Wicks Consulting and others) across the industry over the last two seasons show extreme variability between the number of sprays for a given yield within farming districts. The data for a large number of adjacent fields (Figure 6) at Boggabilla for the 1998/99 season indicates no correlation between the number of sprays for heliothis and yield for both INGARD® and conventional fields in a season where densities were high. Further analysis of the effect of heliothis pressure on spray programs may be found in the paper in these proceedings by Martin Dillon, An Analysis of Pest Pressure in an Area-wide Management Group.

Figure 6. Yield and sprays for heliothis for 37 Ingard and 45 conventional fields from an area–wide IPM group at Boggabilla in northern NSW for the 1998/99 season.



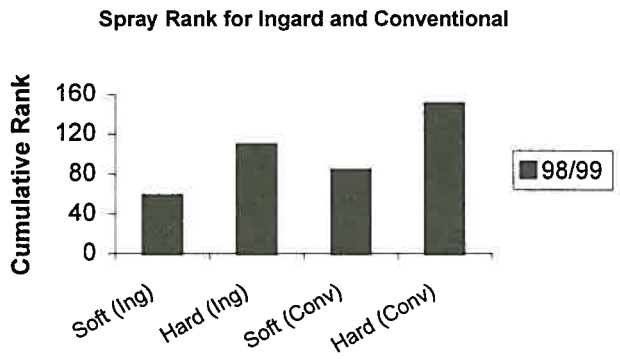
Source: Martin Dillon, CRC Experimental Scientist, ACRI.

Growers and consultants are familiar with comparing spray cost and spray number when assessing pest control yet neither measure reflects the ecological integrity of the program. The questions that growers and

consultants ask about the cost benefit of IPM have been studied and are presented in the paper in these proceedings by Ziaul Hoque et al, An Economic Evaluation of an on-going IPM Program within the Australian Cotton Industry. In this study, spray programs were ranked by weighting individual chemicals for their impact on beneficials, the higher the impact the greater the weight (eg. Bt = 1, SP = 7). The sum of the weights for each chemical in the spray program is the final rank, which reflects both the number of sprays and the chemistry used.

Analysis of the farm data set from Boggabilla (Figure 7) shows that even the least sprayed crops in 1998/99 had relatively high ranking which reflected the multi-adversity of that season. However, there were spray programs that were twice as hard within a relatively small area. This difference in spray regime represents a significant difference in selection pressure on our major pest. An important challenge for growers and consultants is to understand that we will all pay the long-term price of any unnecessary sprays applied each season. Insecticide resistance means pests are more expensive to control and yield losses will also increase.

Figure 7. Spray programs ranked as Soft and Hard for INGARD® and conventional for 98/99 season from an area–wide IPM group at Boggabilla in northern NSW.



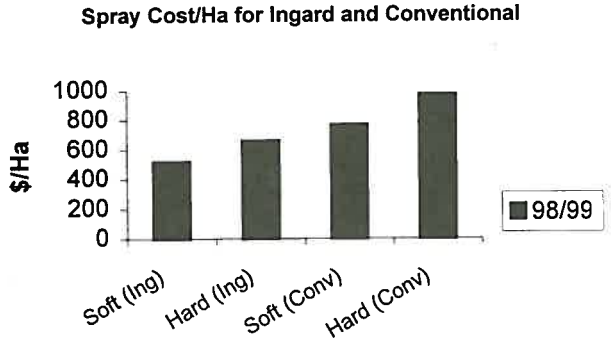
1998/1999 – the season from hell

The 1998/99 season was notable for a diverse range of pest species, higher than average insecticide costs and lower than average yields in many areas. Pest species included heliothis, tipworm, mirids, aphids and mites at unusually high densities in most cotton areas. Production was characterised by extreme variability in yield and many low yielding crops also had higher than normal insecticide costs (Wicks, 1999). Although difficult to establish now, it would seem that Bonsai Bunchy Top (BBT) had a greater impact on some yields than was apparent prior to harvest.

The comparative analysis of the Boggabilla data suggests that BBT was not a factor in the performance of fields in this study. In this analysis (Wicks, 1999) the conventional fields with the highest gross margin (GM) had the lowest spray costs overall, 32% lower than average and the lowest insecticide costs in each stage of the IRM Strategy. Yield was important to GM but lower spray costs also made a significant contribution to the highest GM. Yields of the conventional fields with the highest GM were only 7% above the average.

When spray programs were ranked for their impact on beneficial insects (Hoque *et al*, 2000) it was apparent that the softer spray programs also had consistently lower costs (Figure 8). In 1998/99 both soft INGARD® and conventional fields had spray costs 21% lower than INGARD® and conventional fields in the hard group.

Figure 8. Spray cost for INGARD® (includes licence) and conventional (Soft and Hard programs) for 98/99 season from an area–wide IPM group at Boggabilla, in northern NSW. (20 fields per group).

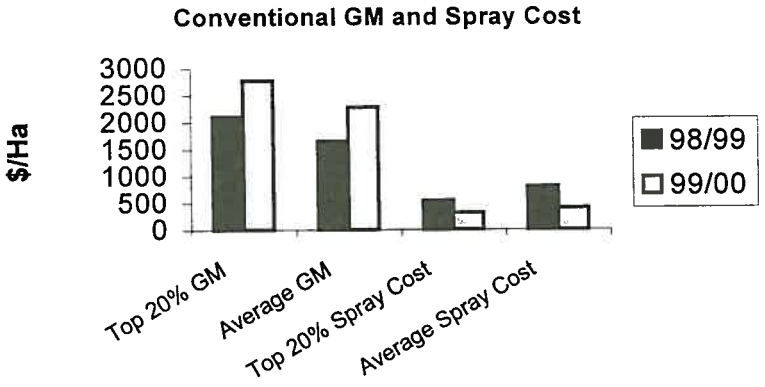


1999/2000 – the season from heaven

The 1999/00 season was characterised by low pest pressure, lower than normal spray costs and higher than average yields in many cotton areas (where cotton was harvested before unseasonable rainfall). This combination of factors has resulted in high contributions to gross margin from both high yield and low costs. Unlike the previous season, the relative scarcity of insect pests enabled growers and consultants to monitor pests, beneficials and plant development more effectively. In turn, this developed confidence in taking a less interventionist approach to pest management and many pest managers agonised over spray product choice.

The comparative analysis study of the Boggabilla area-wide management group was repeated for the 1999/2000 season. In this analysis, Figure 8 (Wicks, 2000), the conventional fields with the highest gross margin (Top 20% GM) had the lowest spray costs overall, 28% lower than the average. Yield was important to GM but lower spray costs also made a significant contribution to the highest GM. Yields of the conventional fields with the highest GM were only 9% above the average.

Figure 8. Gross margin and spray costs for conventional fields for 98/99 and 99/00 seasons from an area–wide IPM group at Boggabilla in northern NSW. Source: Chris Wicks.



When profitability is more important than productivity

Our industry has a fine tradition of striving for excellence in production. High yields are viewed as a measure of success. The contribution of yield to gross margin and by definition profitability is significant especially prices are high. The comparative analysis of a number of farm programs also indicates that spraying only when necessary, using the most selective product, within the IRM strategy also makes a significant contribution to profitability through increased yields, lower costs and higher gross margin. IPM is Best Management Practice in pest management and is necessary for the long-term viability of our industry.

Australian cotton IPM is becoming more complex, those who do not participate will be left behind. We are all learning together about IPM and research and development is continuous. Many growers have recognised that they can learn a lot from others and that IPM involves planning for pest management with their adviser and neighbours. Preserving beneficial insects, allowing for plant compensation, using a threshold and utilising all the components of the IRM strategy are the basis of IPM in Australian cotton. The challenge in developing a commitment to IPM is to have the confidence to put the research into practice, together.

Acknowledgments

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