Career Opportunities for Weed Scientist

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There has probably never been a more important time to consider a career in the agricultural sciences, especially Weed Science! As we face the future, we'll have little choice but to face the age-old problems of hunger and resource limitations, but now on a global scale. To begin to meet this need, we must recognize that the solutions of the past just won't bring us any further than they already have. We are rapidly approaching a point where we, as a people, will no longer be insulated by the apparent abundance of food and as we approach the future, there are going to be greater and greater demands for agricultural output; this can't happen without an embrace of all forms of agriculture and a deep commitment to technology and innovation. We need to be producing more food, not less, to meet the needs of an expanding population. While the scale of this challenge is a bit intimidating, these difficult circumstances also bring us enormous opportunities to do things in new ways and this will require dedicated scientist, technicians and agricultural practitioners with new ways of seeing the world.

Here are several facts that should make you uncomfortable (and this is just a small subset of what's really going on!)!

- In late 2007, several factors pushed up the price of grains consumed by humans as well as used to feed poultry and dairy cows and other cattle, causing higher prices of wheat (up 58%), soybean (up 32%), and maize (up 11%) over the year.
- Food riots took place in several countries across the world (Morocco, Yemen, Mexico, Guinea, Mauritania, Senegal, Uzbekistan and Pakistan). Contributing factors included drought in Australia and elsewhere, increasing demand for grain-fed animal products from the growing middle classes of countries such as China and India, diversion of food grain to biofuel production and trade restrictions imposed by several countries.
- An epidemic of stem rust on wheat caused by race Ug99 is currently spreading across Africa and into Asia and is causing major concern.
- Approximately 40% of the world's agricultural land is seriously degraded. According to UNU's Ghana-based Institute for Natural Resources in Africa, if current trends of soil degradation continue, the continent might be able to feed just 25% of its population by 2025,
- Water deficits, which are already spurring heavy grain imports in numerous middle-sized countries, including Algeria, Iran, Egypt, and Mexico, may soon do the same in larger countries, such as China or India.

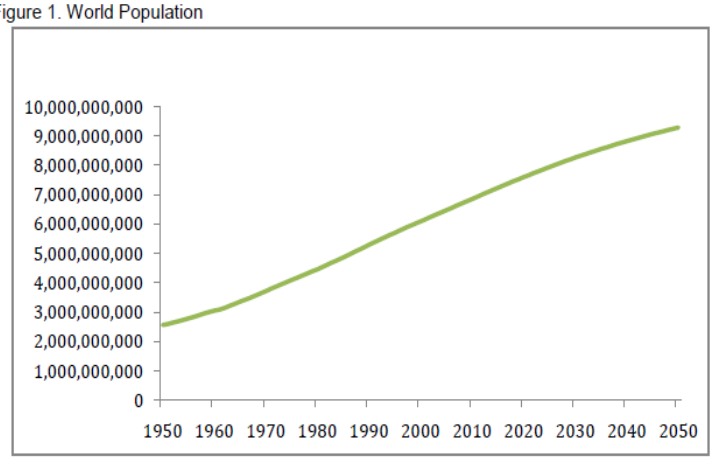
The Moral Imperative for a Career in Agriculture:

The world is getting smaller and crowded! By 2050, the world's population is expected to grow to nearly nine billion (figure 1) – the equivalent of two more Chinas – and all the while, the

ratio of agricultural land to population continues to decrease. The UN FAO predicts that global food production must double by 2050, and 70 percent of the world's additional food needs can be produced only with new or adapted agricultural technologies.

We've all seen charts like figure 1 below which depicts the projected rate of global population growth. And we know that this increase in population also means an increased demand for food, water, land, and other resources. Simply put: we will need to produce more food to feed more people.

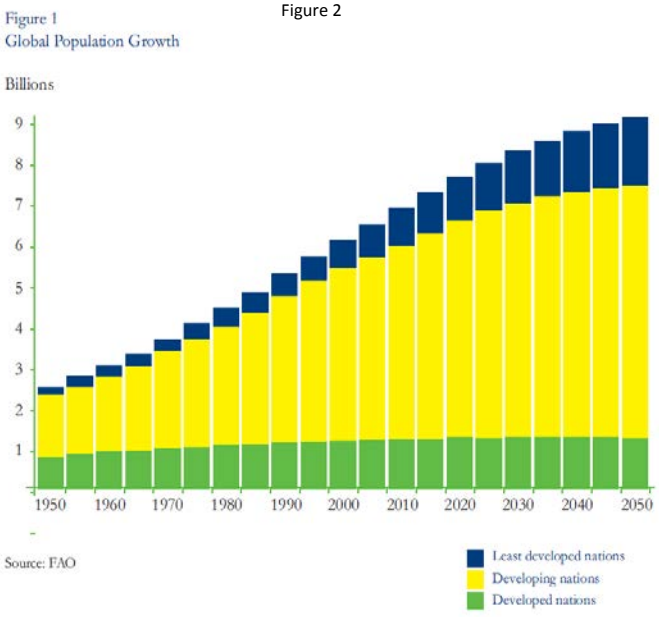
Figure 1. World Population



Source: U.S. Census Bureau. International Database. (Retrieved September 16, 2010). Available from: www.census.gov/ipc/www/idb/region.php

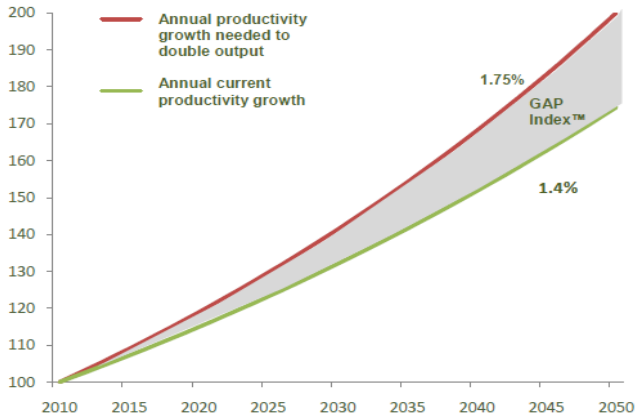
But this is a simple view. Let's add just one layer of complexity to this graph (figure 2).

Figure 2



This view breaks down the same projections by economic standing. At the bottom of the chart are the developed countries – such as the United States and much of Western Europe – which will show little growth and will, in fact, dip slightly over the next 40 years. At the top of the chart are the least developed countries – countries like Ethiopia, Liberia, and Tanzania in Africa, as well as Bangladesh, Cambodia, and Yemen in Asia, Samoa in the Pacific, and Haiti in the Caribbean. They will grow significantly within their category, but it's the middle of the chart where there's a cause for concern: developing nations, such as China, India, Egypt, and much of Eastern Europe, will continue to be the largest population and will also see dramatic growth over the next 40 years.

Figure 3. The Global Agricultural Productivity Index™



Source: Farm Foundation, NFP calculations (2010) based on USDA ERS data.

Figure 3 shows the gap between the current annual productivity growth rate (the bottom line) and the rate of growth needed to double production (the top line) without additional land resources.
What it boils down to is that we must increase the rate of productivity growth an average of 25% every year over the next 40 years just to meet the needs of the global population growth.
From even this simplest of viewpoints, there's already a projected gap of 1/3%, that's as of this morning.

There are many opportunities to contribute to the growth in productivity we need and Weed Science is just one, but it's a critical one! Weeds cause severe yield losses in arable and horticultural crops, which may be more than 34% worldwide. Weeds compete with crops for water, nutrients, light and space reducing crop yields. Weeds also contaminate seeds, foul milk, slow tillage, and interfere with harvesting practices as well as harboring diseases, insects and nematode pests. Additionally, weeds poison livestock, interfere with transportation, create fire hazards, block waterways, obstruct power lines and reduce land values. When the costs of weeds

are combined with the cost of their control, the economic impact was calculated to be over $34 Billion[i].

Weed Scientist are called upon by growers, homeowners, and private or public agencies to provide information on Weed Biology and Management. Though the goals for industry academia do differ, there is substantial overlap, the objectives of each group are:

- Industry Scientist:
  - Generate new knowledge on herbicide Mode-of-Action and in chemistry, biochemistry and formulations science
  - Create, develop and make available new technology and vegetation management solutions
  - At the practitioner level, we apply these solutions to increase productivity.
- University Scientist (all roles) are expected to:
  - Train students in the art and science,
  - Generate and make public new knowledge on the biology, ecology, spread, and control of weed species in agriculture, aquatics, urban environments, parks and other recreation areas
  - Generate new knowledge on the interactions of taxa involved in natural and managed ecosystems.
  - Transfer that knowledge and technology to the practitioner

Weed Scientist have "new" and critical global issues trends that must be addressed, these will drive the future of the discipline and the define job opportunities in the twenty first century:

1. Serious problems with herbicide resistance require a re-thinking of weed management strategies in all crops
2. Impressive growth in the Agricultural Science Companies driven primarily by the development of transgenic crops with input and output traits require highly trained scientists and technicians
   a. Weed scientists, plant physiologists, molecular biologists, plant breeders, entomologists, plant pathologists, etc.
3. And the Organic Growers are desperate for solutions.

There are demographic trends in Weed Science that must be addressed if we are going to be able to populate the discipline:

- Will there be enough highly qualified Weed Scientists to satisfy demand in the public and private sector in the next 5 to10 years?
- Many Weed Scientist in academia and industry are expected to retire in the next 5-10 years (median age $\geq$ 55-58 years)
- In 2009, there were almost 5-times as many graduate students in entomology (1032) and 3-times as many in plant pathology (624) compared to Weed Science (220)[ii].

Qualifications!

- To work as a Weed Scientist in the greenhouse or field, you should:

- *Be fascinated by weed science* (including taxonomy and plant ecology), soil science, and agriculture.
- Have a minimum of a Bachelor's degree in a field such as agronomy, plant science, horticulture, range science, soil science, chemistry, biochemistry, genetics, or Ag engineering.
- For a laboratory research career you'll need a degree in chemistry, biochemistry, plant science, genetics or plant physiology.
    - *For research positions past technician, you'll need a Graduate degree.*
- To work in business, you should have an interest in sales, marketing, and economics plus a BA degree in business with emphasis on agribusiness or agricultural economics.
    - An MBA is helpful, but best with some on-the-job experience.

The jobs categories for Weed Scientists are only limited by your creativity, but here are a few!

- University Weed Scientist
- Farm Advisor, Extension Agent or Specialist
- Government Researcher (USDA ARS)
- Crop Protection Industry (at many levels)
- Pest Control Advisor or Certified Crop Advisor
- Professional Applicator
- Federal Regulatory (EPA) or State (DPR)

More-or-less typical University Weed Scientist job description:

- Responsibilities may include 55% research, 40% teaching, plus 5% advising and university service.
- Expected to develop an externally funded program in some area of plant production or agroecological research including specialty crops and teach classes in the same subject area.
- Develop research publications in peer-reviewed journals, teach and direct undergraduate and graduate students
- Create timely technical publications, training materials and programs for county extension staff, producers, agribusiness firms and other agencies
- Work independently and as a member of an interdisciplinary team to provide leadership for planning and implementing a statewide education programs.
- May also need to develop a strong extension and applied research program to evaluate new cultivars and agricultural technologies.

More-or-less typical Extension Weed Science Specialist job description:

- Leads in planning, implementing, and evaluating educational programs to *transfer weed control technologies.*
    - Knowledgeable in a broad range of weed control methods, chemical to cultural or mechanical.
    - Ability to explain the economic and environmental aspects of each option.

- Work with Farm Advisors, other Extension Specialists, faculty, land managers and the industry to conduct research on unmet State and local weed management needs.
- Develop a nationally competitive research program and obtain extramural grant funds.
- Minimum qualifications include:
  - Evidence of ability to communicate orally and in writing,
  - Ability to work effectively in a team environment with Extension and agribusiness personnel
  - Ability to effectively instruct undergraduate and graduate students
  - Skills regarding the effective use of electronic media in education and communication of technical information.

Weed Science Careers in USDA Agricultural Research Service:

- ARS is the principal research agency of the USDA charged with extending scientific knowledge and solving agricultural problems.
- Weed Scientist career options exist in two programmatic areas:
  - Natural Resources and Sustainable Agricultural Systems and
  - Crop Production and Protection.
- Program goals include research to improve strategies for cost-effective management of native and invasive weed pests, while minimizing impacts on the environment and human health.
- Careers span a variety of disciplines - chemistry, plant physiology, plant pathology, genetics, microbiology, engineering, soil science, and agronomy.
- Grade levels for research scientist positions in ARS are set using the Research Position Evaluation System (RPES).
  - The RPES is a peer review system based on the "person-in-the-job" concept and scientists have open-ended promotion potential based on their personal research and leadership accomplishments, this can change the complexity and responsibilities of their positions.

Careers as a California Pest Control Advisor

- A**ny person who offers a recommendation** on any agricultural use of a pest control product or technique and presents himself/herself as an authority on any agricultural use, or solicits services or sales for any agricultural pest control tool is a **Pest Control Adviser (PCA)**.
- **PCAs are tested to insure they're knowledgeable and proficient in all aspects of crop production and management.**
  - Exams are given (approximately) each month.
- **To become a PCA,** you must meet specific educational requirements, pass the laws, regulations, and basic principles exam, and pass an exam in a pest control area.
  - **Educational requirements:** At least 45 college-level semester units (67.5 quarter units) of required courses in the biological, agricultural, and pest management sciences.
- **California requires continuing education (CE)** for PCAs and pesticide applicators prior to license renewal.

There are many Weed Science roles in Industry, here's just a few:

- Field research scientist
- Discovery scientist (biologist, chemist, biochemist, molecular biologist)
- Characterization leader for discovery technology
- Technical expert to support commercial products
- Technology transfer

Opportunities in Industry don't preclude academic involvement and industry Weed Scientists have the opportunity to:

- Publish with academic scientists
- Accept Adjunct professorships
    - Stay involved with professional societies and participate and Associate Editors for scientific journals and act as Scientific Society Officers

Industry Field Research Scientist job description:

- Thrives in a fast-paced working environment as a part of a research and development team.
- Collaborates with other R & D team members to shape and meet product development goals
- Plans and conduct field, greenhouse and laboratory based experiments to evaluate plant health and herbicide efficacy.
- Generates, collect and prepare experimental data for presentation both internally and at regional and National scientific meetings.
- Coordinate with field and greenhouse staff to properly prepare fields and obtain permits and supplies necessary for research.

OK, I'm a field scientist… what's next???

- The opportunities moving forward are diverse and plentiful!
    - People leadership?
    - Regulatory?
    - Discovery?
    - Project leader?
    - Commercial?
    - Career field scientist?

Opportunities in Industry progress through a Variety of Roles and Work Experiences…

- Within a job, will likely work on a variety of projects over time and train in other disciplines
- Job change can be good to maintain enthusiasm and stimulate learning
- Job change does not necessarily require a geographical move

Non-technical competencies are important in any and every role! Non-technical competencies are:

- The basis for personal and professional effectiveness
- Transferable from one project, job/role to another
- Provide evidence of sustainable ability and flexibility
- For recruiting and hiring purposes, serve as strong discriminating factors when evaluating a large pool of available technical talent
    - Note: Non-technical skills are seldom formally taught in graduate school

Examples of Non-technical skills (Also called Key competencies)

- Leadership
- Teamwork
- Embraces Change
- Initiative/Accountability
- Interpersonal effectiveness
- Innovation & Value creation

These skills form basis of an employee performance review in almost any position!

In summary, Weed Science Careers are:

- Interesting, rewarding, important and diverse careers
- Can be found within Academia, Government, Multi-national crop protection companies and at the local level
- Continuous learning and improvement combined with flexibility are essential for personal growth
- Non-technical "soft skills" are critical for success and interpersonal effectiveness

There's never been a better time to be in the Agriculture Sciences!

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[i] Pimentel D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics 52 (2005) 273– 288

[ii] Derr J. and A. Rana. 2011. Weed Science Research, Teaching, and Extension at Land-Grant Institutions in the United States and its Territories. Weed Technology 2011, 25:277-291