Photography: An Educational Tool in Weed Science

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Introduction

The use of photography in weed science, or agriculture in general, should be a rewarding experience that can add immeasurably when documenting field research. Photography may also be used to visually record various agricultural situations that will help understand what was happening. These slides or photographs can be used in many ways; in conjunction with an oral presentation to better understand the subject matter, stock photography to be used by a company or university to put together slide sets of various crops and/or pest management problems/situations, and private industry may use these slides/photographs in advertising literature. No matter how it is used, photography is a useful "tool" in agriculture and bringing a camera along while at work can also make a job more interesting.

Understanding the basic principles in photography is important in order to capture the image as the photographer wants others to see it. In this day of "auto-everything" cameras, it sometimes takes the creativity away from the photographer and leaves the image completely up to the whim of the camera. Realizing that most results from a completely automatic camera will be satisfactory much of the time, there is still a need to understand what is going on when a photograph is "shot". Separating a "photographer" from a "picture-taker" sometimes means switching that camera from automatic to manual and understanding what is going on when you depress that shutter button. A knowledgeable photographer will also make the right decision when choosing the appropriate lens and film to obtain that desired result.

With a basic understanding of certain photographic concepts such as exposure and depth-of-field, an individual may be challenged to take the camera off the automatic mode and attempt some creativity by manually operating the camera.

Exposure

In everyday photographic terms, exposure means the picture taken on a roll of film (ie: a 36 *exposure* roll). **Defined another way, exposure is a quantity of light or the amount of light (intensity x time) that reaches the film, reproducing a desired image.** Exposure is a function of three variables; film speed, shutter speed, and aperture. An almost infinite combination of these variables will produce the quantity of light necessary for a correct exposure. The photographer has the freedom to decide how these variables will be used. Of course today's high tech automatic camera is programmed to decide for the photographer the best all around exposure, but a whole new photographic world is opened up when that same camera is switched to manual. Creativity is what separates the photographer from the picture-taker.

Film Speed

The film speed is based on the film's sensitivity to light and is identified by an "ISO" number. Fast films (high ISO numbers) are more light-sensitive than slow films (low ISO numbers). Fast films require less light to expose the film. Slow films usually have an ISO rating up to 100 (ie: Kodachrome 25, Kodachrome 64, Sensia 50). A medium speed film would be from ISO100 - ISO200 and would include Elite II 100 and Sensia 100. Films that are considered fast have ISO numbers between 200-400, and the extra-fast films are above ISO400.

The sensitivity of ISO400 film is twice that of ISO200 film and requires 1/2 the light to obtain an equivalent exposure. For example; if ISO400 film requires a 1/500 second exposure, then the ISO200 film would require a 1/250 second exposure, and an ISO100 film would have successful results with a 1/125 second exposure.

Selection of the right film speed depends on the intent of the photographer. Films of medium speed (ISO100-ISO200) are the most common for everyday photography. Films with faster speeds (>ISO200) are generally used under low light conditions.

Shutter Speed

The shutter speed is the length of time the camera's shutter remains open, exposing the film. Typical shutter speeds are usually indicated by the reciprocal number in seconds; 1000 = 1/1000 second, 500 = 1/500 second, 250 = 1/250 second, 125 = 1/125 second, etc.. Slow shutter speeds would be effective to show movement (ie: the blurred walnuts or almonds as they are being shaken from the tree at harvest). A fast shutter speed could include a stop-action shot of a crop duster. Most cameras also have a bulb (B) setting for timed exposures. In the case of the bulb setting, the shutter remains open for a predetermined amount of time based on manually holding in the shutter button or a preprogrammed time on an automatic camera.

Aperture

The aperture is simply the lens opening, and is commonly referred to in "f/stops". A typical range of apertures for a lens would be f/22, f/16, f/11, f/8, f/5.6, f/4, f2.8, and f/2. For these apertures, f/22 is the smallest opening and f/2 is the largest. There is also a direct correlation between apertures; the amount of light received doubles at each f/stop increase. If one unit of light passes through the f/22 aperture, two units of light would pass through the f/16 aperture, four units of light would pass through the f/11 aperture. Based on this scenario, by the time the lens was opened up to an aperture of f/2, 128 units of light would pass through the lens.

Remember that when changing one of the three exposure variables like aperture, there must be a corresponding change of the shutter speed and/or film speed to obtain an equivalent exposure. Of course the camera may already have done that automatically.

Depth-Of-Field

When viewing photographs, some appear to be in sharp focus from front to back, while others only part seems to be sharp. This is called the depth-of-field, and it is the distance range

where everything will be in sharp focus. The depth-of-field is variable and directly related to the lens aperture. **The smaller the aperture, the greater the depth-of-field.** For example, with a standard 55mm. lens focused on an object 10 feet away, the depth-of-field at the f/2 aperture will total only two feet (9.5' to 11. 5' from the camera), at f/11, the depth-of-field is 16 feet (7' to 23' from the camera), whereas at the f/22 aperture, the depth-of-field will be from five feet to infinity. Depth-of-field is one of the most important considerations in photography. It appears that in many photographic situations, maximum depth of field is preferred. That means being aware of the aperture, and making sure to use the smallest aperture possible.

If maximum depth-of-field is the objective in a scene out to objects at "infinity" as indicated on the camera lens, there is a way to insure that depth-of-field is maximized. It's called **hyperfocal distance**. When the lens is focused at infinity, the near limit of depth-of-field for the preset aperture is called the hyperfocal distance (There is usually a depth-of-field scale shown on the lens barrel with markings for the various apertures). By moving the focus to that distance will result in the maximum depth-of-field for that aperture. If maximum depth-of-field is preferred and this hyperfocal distance technique can't be remembered, there is an easy way to obtain the best sharpness possible rather that just guessing: Set the camera on the smallest aperture possible and focus about 1/3 into the field of view. This technique should result in pretty good depth-of-field in most situations.

As stated earlier, the smaller the aperture, the greater the depth-of-field. However, the depth-of-field for a given aperture will vary depending on the focal length of the lens. For a given aperture, a wider angle lens offers a greater depth-of-field. For example, at an aperture of f/16, the depth-of-field for a 135mm lens is from 50 feet to infinity, whereas the depth-of-field for a 28mm wide angle lens is from three feet to infinity.

In close-up photography, where the subject is being magnified, the depth-of-field becomes very limited and critical. At a 0.1X magnification using a f/16 aperture, the total depth-of-field is 104mm. However, when a subject is magnified to 1.0X (life-size), the total depth-of-field is down to only 2mm.

Manipulating the depth-of-field is important to obtain the desired result. Maximum depth-of-field may not always be wanted. By using **selective focus**, a large aperture will narrow the depth-of-field and highlight a sharp subject from an otherwise confusing picture. By focusing only on the subject (i.e.: weed seedling) and blurring the cluttered background, the subject will stand out and therefore be easily identified.

Slide Films

Only slide film is being discussed for two reasons: First, most individuals in weed science research will use slides more often than photographs. Secondly, photographs are easily and relatively economically made from slides. The most common and readily available slide films on the market are Kodak's Kodachrome 64 (ISO64) and Elite II 100 (ISO100). Fuji's Sensia 100 (ISO 100) is also a very popular slide film that has only been on the market for a couple of years, but has become one of the industry standards.

Kodachrome 64: It seems like this film has been around forever, at least 40+ years. Although the colors are somewhat muted, they are quite consistent whether in full sunshine or used under overcast skies. This film can definitely use a polarizing filter to help exhibit some brighter color. Flesh tones are true with Kodachrome 64 and it is not too contrasty. Kodachrome 64 is a good all around slide film, but not very exciting.

Elite II 100: This new Ektachrome film shows promise. Comparison tests have shown this film to have excellent bright color qualities, but should be underexposed (about 1/2 f/stop) to match the bright colors found in Fujichrome film. Color suffers slightly under overcast skies, but results are still acceptable. Elite II 100 is not hampered by too much contrast. It is an excellent choice and readily available.

Sensia 100: This is a fairly new film, replacing the colorful Fujichrome 100. It's dramatic color is no match for the Kodak films. However, it does tend to be quite contrasty, and the flesh tones can come out rather red. Under overcast skies, the color shifts to a cool "blue", indicating the need for a warming filter (#81A). Even though there are some problems (although correctable) associated with Sensia 100, it is still the first choice for many outdoor photographers.

Cameras and Lenses

Anyone who has visited a camera store or browsed through a photography magazine recently has to be overwhelmed at the number of cameras on the market. Just 20 years ago it seemed like each manufacturer had a small line of cameras and they looked and worked just like their competitors. But today, with all the high tech gadgetry, there are a myriad of choices that boggles the mind. Viewfinder cameras have come a long way since they were all fixed focal length and usually resulted in photographs of marginal quality. These cameras don't "see" through the lens, but have a straight through area to view the subject. The current viewfinder cameras have elaborate zoom lenses that range from 28mm to 140mm, and have many features, resulting in good photographs. There are a couple of problems with this type of camera. They are not very good for close-up photography since a person can't see exactly what's in the lens and that is important for proper composition. Another problem with viewfinder cameras is that since there's no manual override, results are at the mercy of the automatic mode, and that might not be what is desired. They can also be quite expensive for what they do.

If there is a choice in selecting a camera, the single lens reflex (SLR) is the only way to go. It's important to see exactly what the picture area will be and through-the-lens viewing is what a SLR is all about. Interchangeable lenses is a big plus when comparing SLRs to viewfinder cameras. No serious photographers would limit themselves to only one lens (well, maybe a fullrange zoom, which may have questionable quality considerations). These new cameras have autoeverything, which is fine, especially the auto-focus for people whose eyesight is beginning to become somewhat unreliable. Generally, the auto-everything cameras will give very good results most of the time, but there still should be a manual override for those who really want to get creative.

Lens selection is as important as the SLR camera body being purchased. Wide angle lenses (35mm, 28mm, and even the super-wide 20mm) are very effective in encompassing areas so a person doesn't have to back up several hundred feet to get everything in the photograph. Wide angle lenses are also good for that low angle, dramatic shot of a harvester, sprayer or whatever the photographer wants to capture. Since there can be considerable distortion with the wider angle lenses, care should be taken to not overdue it. The telephoto lens (105 to 200+ mm) can be useful, but is not used nearly as much as a wide angle lens. A telephoto lens is good for photographing people when approaching them too close may result in losing that "candid" effect. Telephoto lenses are useful when a sprayfig is in operation and getting too close may result in unwanted spray deposits on the camera and photographer. Compressing subjects are easily attained with a telephoto lens. Using a long lens to photograph a nearby subject with mountains in the background will result in a picture that looks like the subject is almost touching the mountains. A zoom lens, like a 28-105mm or 35-135mm will probably encompass most needs of a photographer in the weed science field. Using a zoom lens is also a lot easier than continually changing lenses.

The final lens in the photographer's arsenal should be some kind of close-up lens, to allow for photographing small subjects like weed seedlings, insects, and close-ups of plant diseases. Some zoom lenses have "macro" stamped on the barrel or state "close-up" on their advertising literature, but in reality only magnify a little larger than the standard lens, which isn't much. For real close-up work, a lens should be capable of magnifying up to somewhere between 1/2 to full life-size (in other words, filling the viewfinder with a subject up to the size of the film (1" X 1 1/2"). Generally these are fixed focal length close-up lenses of anywhere from 50mm to 105mm. The 50mm lens forces the photographer to be just inches away from the subject, whereas the 105mm lens allows more working distance from the subject. A problem with a longer working distance between lens and subject is there's more area for unwanted clutter to interfere with getting a clear shot of the subject.

Conclusion

Understanding the basics of photography is important if the photographer wants to capture the subject on film exactly as desired, with the fight lens, film, lighting, and composition. This is also very important in purchasing the fight equipment for what and how subjects are to be photographed. Probably the most important factor in great photographic results is time. If a person doesn't want to or can't take the time necessary for quality results, then they become just a person taking pictures and can't expect many eye-catching results.