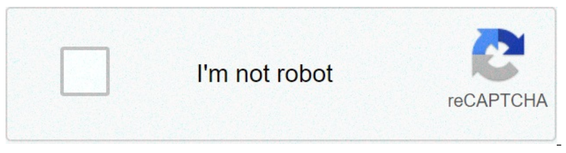

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What are the 4 main principles of natural selection

The conditions inherent in our cropping systems makes weed success inevitable. Natural selection, diversification, evolution and adaptation are the important events that weed populations have experienced for the history of agriculture. In this unit we will explore these fundamental forces and processes and form weed communities and drive the appearance and changes in the weeds we have. natural selection: 1: process by which forms of organisms in a population that are best adapted to the environment increase in frequency relative to less well-adapted forms over a number of generations. 2: the non-random and differential reproduction of different genotypes acting to preserve favorable variants and to eliminate less favorable variants; viewed as the creative force that directs the course of evolution by preserving those variants or traits best adapted in the face of natural competitionPre-conditions for natural selection. The preconditions to natural selection are excess fecundity and the consequent competition for limited resources. Weeds produce many more seed than will survive. Many more seed germinate and form seedlings than will mature to produce their own seed. Only the successful competitors will reproduce, mortality is very high. Four (4) conditions for natural selection. Four conditions are needed for natural selection to occur: reproduction, heredity, variation in fitness or organisms, variation in individual characters among members of the population. If they are met, natural selection automatically results. 1: Reproduction: the act or process of producing offspring A condition necessary for evolution to occur is that a parent plant produces more offspring than can normally survive. The net (average) result of reproduction is that a parent plant leaves one descendant that reproduces, yet many more are produced that die. See Life History for full treatments of reproduction in weedy populations. 2: Heredity: the mechanism of transmission of specific characters or traits from parent to offspring. inheritance: the transmission of genetic information from ancestors or parents to descendants or offspring. A condition necessary for evolution to occur is that the traits of the "fittest" phenotypes that survive are inherited by the successful progeny. The offspring must tend to resemble their parents. Molecular genetics and biochemistry provide significant information about how this process occurs. 3: Variation in fitness of organisms. Definitions of fitness: 1: the average number of offspring produced by individuals with a certain genotype, relative to the numbers produced by individuals with other genotypes. 2: the relative competitive ability of a given genotype conferred by adaptive morphological, physiological or behavioral characters, expressed and usually quantified as the average number of surviving progeny of one genotype compared with the average number of surviving progeny of competing genotypes; a measure of the contribution of a given genotype to the subsequent generation relative to that of other genotypes A condition necessary for evolution to occur is variation in fitness of organisms according to the state they have for a heritable character. Individuals in the population with some characters must be more likely to reproduce, more fit. Organisms in a population vary in reproductive success. We will discuss fitness in Life History when we discuss competition, interference and the effects of neighbor plants. See also pages on Fitness & Fecundity in the reproductive life history section. 4: Variation in individual characters among members of the population jdekker-2007 Page ID13414 Contributed by BoundlessGeneral Microbiology at Boundless Charles Darwin and Alfred Wallace independently developed the theories of evolution and its main operating principle: natural selection. Learning ObjectivesExplain how natural selection can lead to evolution Key Points Wallace traveled to Brazil to collect and observe insects from the Amazon rainforest. Darwin observed that finches in the Galápagos Islands had different beaks than finches in South America; these adaptations equiped the birds to acquire specific food sources. Wallace and Darwin observed similar patterns in the variation of organisms and independently developed the same explanation for how such variations could occur over time, a mechanism Darwin called natural selection. According to natural selection, also known as “survival of the fittest,” individuals with traits that enable them to survive are more reproductively successful; this leads to those traits becoming predominant within a population. Natural selection is an inevitable outcome of three principles: most characteristics are inherited, more offspring are produced than are able to survive, and offspring with more favorable characteristics will survive and have more offspring than those individuals with less favorable traits. Key Terms natural selection: a process in which individual organisms or phenotypes that possess favorable traits are more likely to survive and reproduce descent with modification: change in populations over generations In the mid-nineteenth century, the mechanism for evolution was independently conceived of and described by two naturalists: Charles Darwin and Alfred Russel Wallace. Importantly, each naturalist spent time exploring the natural world on expeditions to the tropics. From 1831 to 1836, Darwin traveled around the world to places like South America, Australia, and the southern tip of Africa. Wallace traveled to Brazil to collect insects in the Amazon rainforest from 1848 to 1852 and to the Malay Archipelago from 1854 to 1862. Darwin’s journey, as with Wallace’s later journeys to the Malay Archipelago, included stops at several island chains, the last being the Galápagos Islands west of Ecuador. On these islands, Darwin observed that species of organisms on different islands were clearly similar, yet had distinct differences. For example, the ground finches inhabiting the Galápagos Islands comprised several species with a unique beak shape. The species on the islands had a graded series of beak sizes and shapes with very small differences between the most similar. He observed that these finches closely resembled another finch species on the mainland of South America. Darwin imagined that the island species might be modified from one of the original mainland species. Upon further study, he realized that the varied beaks of each finch helped the birds acquire a specific type of food. For example, seed-eating finches had stronger, thicker beaks for breaking seeds, while insect-eating finches had spear-like beaks for stabbing their prey. Figure \(\PageIndex{1}\): Beak Shape Among Finch Species: Darwin observed that beak shape varies among finch species. He postulated that the beak of an ancestral species had adapted over time to equip the finches to acquire different food sources. Wallace and Darwin observed similar patterns in other organisms and independently developed the same explanation for how and why such changes could take place. Darwin called this mechanism natural selection. Natural selection, also known as “survival of the fittest,” is the more prolific reproduction of individuals with favorable traits that survive environmental change because of those traits. This leads to evolutionary change, the trait becoming predominant within a population. For example, Darwin observed that a population of giant tortoises found in the Galapagos Archipelago have longer necks than those that lived on other islands with dry lowlands. These tortoises were “selected” because they could reach more leaves and access more food than those with short necks. In times of drought, when fewer leaves would be available, those that could reach more leaves had a better chance to eat and survive than those that could not reach the food source. Consequently, long-necked tortoises would more probably be reproductively successful and pass the long-necked trait to their offspring. Over time, only long-necked tortoises would be present in the population. Natural selection, Darwin argued, was an inevitable outcome of three principles that operated in nature. First, most characteristics of organisms are inherited, or passed from parent to offspring, although how traits were inherited was unknown. Second, more offspring are produced than are able to survive. The capacity for reproduction in all organisms outstrips the availability of resources to support their numbers. Thus, there is competition for those resources in each generation. Both Darwin and Wallace were influenced by an essay written by economist Thomas Malthus who discussed this principle in relation to human populations. Third, Darwin and Wallace reasoned that offspring with the inherited characteristics that allow them to best compete for limited resources will survive and have more offspring than those individuals with variations that are less able to compete. Because characteristics are inherited, these traits will be better represented in the next generation. This will lead to change in populations over successive generations in a process that Darwin called descent with modification. Ultimately, natural selection leads to greater adaptation of the population to its local environment; it is the only mechanism known for adaptive evolution. Papers by Darwin and Wallace presenting the idea of natural selection were read together in 1858 before the Linnean Society in London. The following year, Darwin’s book, On the Origin of Species, was published. His book outlined his arguments for evolution by natural selection. Figure \(\PageIndex{1}\): Charles Darwin and Alfred Wallace: Both (a) Charles Darwin and (b) Alfred Wallace wrote scientific papers on natural selection that were presented together before the Linnean Society in 1858.

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